Power Configuration
& Analysis Dope

Drawbar Ratings - Hi Strength
TF & Braking Curves
Speed-Tonnage-Grade Tables
Adjustment Factor Explanation
Compensated Curve Dope.

SD-45's
SD-40's
GP-40's
Some on 35's & 30's

B. E. Smith
For your use + info. attn 4/11

TRANSPORTATION
USEFUL FACTS & FORMULAE

General:

To accelerate a train, forces must be applied to balance those forces which oppose train movement and to provide additional force to accelerate the train. These opposing forces are:

1. Train resistance—friction, air, rail bending.
2. Grade resistance—due to lifting the train weight in ascending a grade.
3. Curve resistance—friction between wheel flanges and rails on curves.

Train Resistance:

A great many formulae have been devised to permit calculation of the resistance values of different types and weights of trains. The most satisfactory of these are the Davis formulae:

		JOURNAL	*FLANGE*	*WIND*
LOCOMOTIVE RESISTANCE lbs./ton	=	$1.3+\frac{29}{W}$	$+ .03V$	$+ \frac{.0024AV^2}{WN}$
PASSENGER CAR RESISTANCE lbs./ton	=	$1.3+\frac{29}{W}$	$+ .03V$	$+ \frac{.0034AV^2}{WN}$
FREIGHT CAR RESISTANCE lbs./ton	=	$1.3+\frac{29}{W}$	$+ .045V$	$+ \frac{.0005AV^2}{WN}$

W=Average Tons Per Axle V=Speed in Miles Per Hour
N=Number of Axles A=Frontal Area in Sq. Ft.
(A=100 for Box Cars and 120 for Piggy-Back Cars)

Grade Resistance:

The percent grade is the number of feet rise per 100 feet length of track. On a 1 per cent grade a ton (2000 lbs.) must be raised *one* foot for each hundred feet the train advances. The resultant grade resistance will equal

$$\frac{2000 \text{ lbs. x 1 ft.}}{100 \text{ ft.}} = 20 \text{ pounds/ton}$$

EXAMPLE

TRAILING TONS AND RUNNING TIME CALCULATIONS

Freight train ascending a grade: (using a U25B-130 ton loco)

1. How many 50-ton freight cars (4 axle) can one U25B locomotive haul at 20 miles per hour up a 15-mile 1% grade with a series of 1.5° curves equivalent to a train length?

   Grade resistance=20 lbs/ton x 1% =20.0 lbs/ton
   Curve resistance=0.8 lbs/ton x 1.5° = 1.2 lbs/ton
   Train resistance at 20 MPH—50 ton cars = 4.9 lbs/ton
   TOTAL Resistance 26.1 lbs/ton

   Tractive effort of one U25B locomotive unit at 20 MPH=38,700 lbs
   (from Specification 3030, assuming locomotive has 74/18 gear ratio)

   Trailing tons=$\frac{\text{Tractive Effort}}{\text{Total Resistance}}$ -- Loco. Wgt.=

   $$\frac{38{,}700}{26.1} - 130 = 1350 \text{ tons or 27 cars}$$

2. What is the running time up the grade?

   Time (in minutes)=$\frac{\text{Distance}}{\text{Avg. Speed}} \times 60 = \frac{15}{20} \times 60 = 45$ min.

DYNAMIC BRAKING CALCULATION

Same freight train descending same grade as above:
Forces retarding train:—Train & Locomotive Friction +Curves
Forces aiding train:—Gravity or % grade
Braking Effort required=Total train resistance x train weight
Total resistance=Algebraic sum of grade, curve and train friction or T.R.= $-20+1.2+6.8=12.0$
Braking Effort=12.0 (1350+130)=17,800 lbs.

From the dynamic braking curve this would be at a max. speed up to 42.0 MPH.

How many cars could one U25B hold with dynamic brakes on this same 1% grade?
(Maximum braking effort from braking curve=42,500 lbs at 20 MPH)
42,500=13.8* (train wgt.+130) *($-20+1.2+5.0=13.8$ lbs/ton)
Train wgt.=2950 tons or 60 cars (could be held without air brakes at 20 MPH)

ACCELERATION

1350-ton—27 car train on a 0.75% grade
Balancing speed is 26 MPH

To find *time* and *distance* required to move this train from standstill to 26 MPH would require detailed calculations of 5 MPH increments for accurate results. However, for approximate values for estimating purposes *two* steps could be calculated for quick reference i.e. 0-20 MPH and 20-26 MPH.

From 0 to 20 MPH (Avg. speed during this step is 10 MPH)

Available tractive effort limited by 25% of driver wgt.= 65,000 lbs.

Train resis=15 lbs/ton (grade)+4.5 lbs/ton (friction)+10 lbs/ton (starting res.)
(Note—*in starting* only 10 lbs/ton used to overcome friction inertia)

Lbs. of tractive effort required to overcome total train resistance=(15+4.5+10)(130+1350)=43,750 lbs.

Net tractive effort available for accelerating 0-20 MPH
Net T.E.=65,000 lbs.−43,750 lbs.=21,250 lbs.

Acceleration=$\frac{21{,}250}{100 \times 1480} = .144$ MPH/SEC

Time to reach 20 MPH=$\frac{20}{.144} = 139$ seconds

From 20 to 26 MPH (Avg. speed=23 MPH)

Available T.E.=34,000 lbs. (from T.E. curve at 23 MPH)
Total train resis=30,000=(15+5.3)(130+1350)
Net T.E.=34,000−30,000=4,000 lbs.

Acceleration=$\frac{4{,}000}{100 \times 1480} = .027$ MPH/SEC

Time required to accelerate train from 20 to 26 MPH=$\frac{6}{.027} = 222$ seconds

Total time to accelerate from standstill to 26 MPH=139 +222=361 seconds

Distance train moved in this time=1.467 x Avg. speed x time=1.467 x 13 x 361=6900 feet (1.3 miles)

Curve Resistance:

A one degree curve is one in which a hundred feet of track is 1/360 of a complete circle. The radius of a *one* degree curve is 5730 feet or

$$\text{Radius of Curvature in feet} = \frac{5730}{\text{Degree of Curve}}$$

$$\text{Degree of Curve} = \frac{5730}{\text{Radius in Feet}}$$

Curve Resistance = .8 lbs. per ton per degree of Curve

Acceleration:

The force required to accelerate a *ton* of train weight at a rate of *one* mile per hour each second is 100 pounds.

$$F = MA \text{ or } \frac{W}{g} A$$

$$F = \frac{W}{32.2} \times 2000 \times A \times \frac{5280}{3600}$$

$$F = 91.1\ WA$$

The rotational acceleration of the wheels, motors, gears, requires approximately 8.9 pounds, which therefore produces a

$$\text{Force} = 100\ WA$$

Thus, if the net tractive force available for accelerating a 2000-ton train were 50,000 pounds, after accounting for all resistances, the acceleration would be

$$\frac{50{,}000}{2{,}000} = 25 \text{ pounds/ton} = \frac{25}{100} \text{MPH/S}$$

Balancing Speed:

The train speed at which all of the available tractive force is used to overcome the various resistances to train movement, leaving no net tractive force for acceleration, is called balancing speed.

Adhesion:

Is the ratio of a *horizontal* force to a *vertical* force, or in railroad terms is the equivalent to

$$\frac{\text{available tractive force (lbs.)}}{\text{total weight on drivers (lbs.)}}$$

and is expressed in a per cent ratio. Experience has indicated that a starting adhesion of 25—30 per cent can be attained, while running adhesions above 20 per cent are almost impossible to hold unless under extreme good rail conditions.

TRANSPORTATION FORMULAE

$$\text{Rail Horsepower (RHP)} = \frac{\text{Tractive Effort} \times \text{MPH}}{375}$$

$$\text{Horsepower (Input For Traction)} = \frac{\text{Rail Horsepower}}{\text{\% Transmission EFF.}}$$

Gross Horsepower (Brake) = Input HP + HP for Auxiliaries

Drawbar Pull (lbs.) = Trailing tons x Total Train Resistance (lbs/ton)

$$\text{Trailing Tons} = \frac{\text{Tractive Effort Available (lbs)}}{\text{Total Train Resistance (lbs/ton)}} - \text{Loco. Wt.}$$

$$\text{Acceleration (MPH/Sec)} = \frac{\text{Net Tractive Effort (lbs)}}{100 \times \text{Weight of Train (tons)}}$$

$$\text{Time (Seconds)} = \frac{\text{Change Speed (MPH)}}{\text{Acceleration (MPH/Sec.)}}$$

$$\text{Time (Minutes)} = \frac{\text{Distance (Miles)}}{\text{Average Speed (MPH)}} \times 60$$

Distance (Feet) = 1.467 x Average MPH x Time (Sec.)

$$\text{Gear Ratio (G.R.)} = \frac{\text{Teeth on Gear}}{\text{Teeth on Pinion}}$$

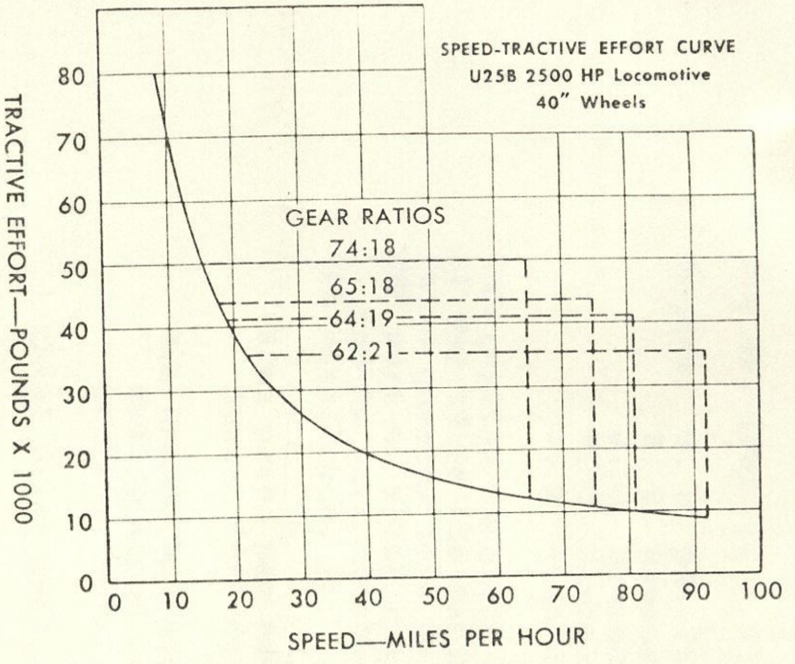
$$\text{Motor R.P.M.} = \frac{336 \times \text{MPH}}{\text{Wheel Diam. (Inches)}} \times \text{G.R.}$$

Tractive Effort varies directly with Gear Ratio

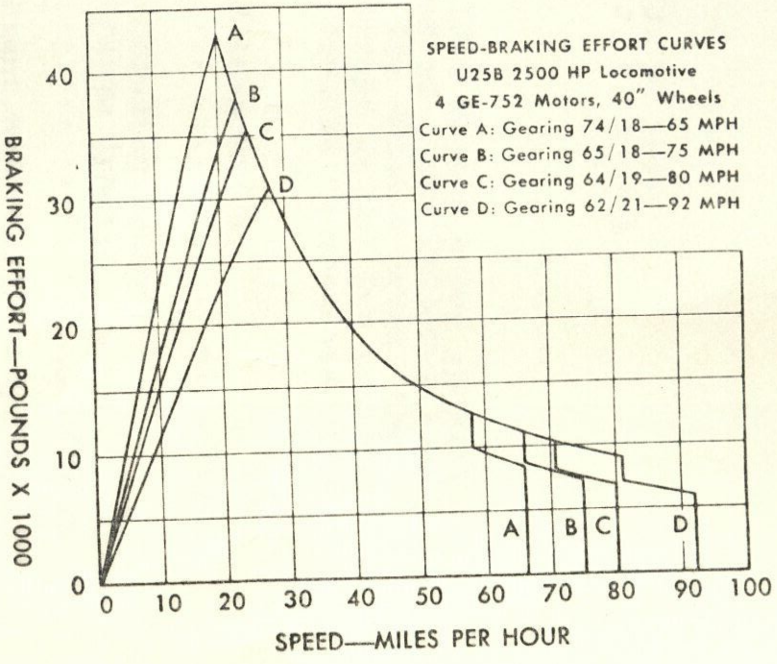
Tractive Effort varies inversely with Wheel Diameter

Speed (MPH) varies directly with Wheel Diameter

Speed (MPH) varies inversely with Tractive Effort



SPEED-TRACTIVE EFFORT CURVE
U25B 2500 HP Locomotive
40" Wheels



SPEED-BRAKING EFFORT CURVES
U25B 2500 HP Locomotive
4 GE-752 Motors, 40" Wheels
Curve A: Gearing 74/18—65 MPH
Curve B: Gearing 65/18—75 MPH
Curve C: Gearing 64/19—80 MPH
Curve D: Gearing 62/21—92 MPH

orig IPA
cc loco file

May 20, 1985

Messrs: T. D. Odwalt
R. C. Hagaman
J. J. Donohue
R. J. Elston
J. T. Hutton
J. B. Love
J. G. Harris

EMD replied verbally May 17, 1985 to the phone inquiry of May 14 re the estimated cost of a new SD-40T-2 for third quarter 1985 delivery. The updated price, the EMD part of which will be confirmed in writing so that it can be part of the record required to caculate the IPA escalation, is:

Base price per new SD-40-2 locomotive, August 1985 delivery....................	$1,023,100
Rio Grande modifications including tunnel Modification, extended range dynamic braking, etc.,........................	191,450
Total price/unit, F.O.B. Plant, McCook, Ill.	$1,214,550
Freight-McCook to Kansas City (based on estimate for recent SD-50 delivery).....................	4,055
Total cost/unit as received at KC	$1,218,605
Cost of supplementary modifications and equipment additions made at Burnham (radios, re-railers, etc.) (based on SD-50 delivery)............	7,200
Estimated third quarter 1985 in-service cost of an SD-40T-2.................	$1,225,805

If for some reason an updated cost for SD-40T-2's is needed, use this one.

J. E. Timberlake

Rec'd 5/29/85
org JTH
cc VBL
IPA
~~Loco File~~

ELECTRO-MOTIVE

ADDRESS REPLY TO
4600 S. 90th Street
Omaha, NE 68127
(402) 339-6926

Electro-Motive Division General Motors Corporation LaGrange, Illinois 60525 (312) 387-6000

May 22, 1985

Mr. J. E. Timberlake
Director, Unit Train Operation
Denver & Rio Grande Western Railroad
1515 Arapahoe Street
Denver, Colorado 80217

SUBJECT: Third Quarter 1985 Pricing
D&RGW SD40T-2 Locomotive
Reference Your Letter of May 20, 1985

Per your request, the following reflects third quarter 1985 pricing for your SD40T-2 locomotives. Pricing is based on your most recent order for SD40T-2's in 1980:

	3rd Quarter 1985 Price
Basic SD40-2 Price....................	$1,023,100
D&RGW Modifications....................	191,450
Total Sell Price, FOB McCook, ILL....	1,214,550

D&RGW modifications include your tunnel carbody modification, trainlined power reduction, plow pilot, oscillating headlight, 4000 gallon fuel tank and extended range dynamic brakes, as well as your other modifications.

Please feel free to contact me if further information is required.

Sincerely,

Mark Turek
Mark Turek
District Manager

MT/MT

orig IPA
cc loco [illegible].

Rio Grande

THE DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY
DENVER, COLORADO 80217

J. E. TIMBERLAKE
Director, Unit Train Operations

May 20, 1985

Mr. M. E. Turek
District Manager
Electro-Motive Division
General Motors Corporation
4534 South 90th Avenue
Omaha, Nebraska 68127

Dear Mr. Turek:

This will confirm my phone request of May 14 for a written quotation from EMD estimating the third quarter 1985 delivery price per unit, F.O.B., McCook, Illinois, of four (4) SD40-T2 locomotives equipped with the standard Rio Grande modifications and additions.

The governing list of such modifications would be those found in our last order, delivered in March 1980, for 16 such locomotives. These included the tunnel modification extended range dynamic brakes, trainlined power reduction, a plow pilot, a mars oscillating headlight, and the 4,000 gallon fuel tank.

Perhaps the quotation might consist of four basic items arranged somewhat as follows:

Quantity (4) and description (based on last order)

Estimated base price per new SD-40-2 locomotive...________

Estimated price of Rio Grande modifications.......________

Total estimated price per locomotive, F.O.B.
EMD's McCook, Illinois Plant.................________

Your help in developing this estimate is much appreciated.

Sincerely,

Timberlake

cc: T. D. Odwalt - AVP Fuels - D&RGW
J. D. Clancy - CMO - DRGW
J. B. Love - Purchasing Agent - DRGW

bcc: L. R. Parsons)This will be used to develop part of the
J. G. Harris)applicable contract rate escalation due
R. C. Hagaman)Rio Grande under the Intermountain Power
J. T. Hutton)Association Agreement which will be
implemented in August

Tram File

Denver - September 23, 1983

Mr. R. C. Hagaman:

The following has been developed in response to your request for an estimate of the March 1983 ready-to-enter-service cost of a General Motors Electro-Motive Division SD40-T2 fully equipped with Rio Grande-specified options and modifications. EMD based the unit costs given below on an assumed 10 unit order:

Price per basic SD40-2 unit FOB EMD plant, LaGrange, Ill.	$894,000		
EMD installed tunnel modification making unit an SD40-T2	$ 39,100		
* Rio Grande-specified, EMD-installed options and modifications	$115,125		
Total cost per unit, FOB LaGrange, Ill.		$1,048,225	
# Freight from McCook (LaGrange) to Kansas City		$ 9,000	
# Rio Grande-added (at Burnham) modifications and equipment		$ 6,135	
Total estimated March 1983 ready-to-roll cost of an SD40-T2 unit			$1,063,360

Attached hereto as supporting exhibits are:

1. The base quote from EMD dated 8/11/83.
* 2. As information, a list of the Rio Grande-specified EMD-installed options and modifications covered by the * item above.
# 3. A list, with estimated costs, of Rio Grande-added modifications and options prepared by J. G. Harris.

On August 9, 1983, Pacific Car and Foundry estimated the cost of a caboose meeting the required regulatory standards at $94,000 per car in lots of 25 units. No attempt has been made to estimate freight or additional equipment costs for the cabooses. Paccar's letter to Mr. Silverman is attached as Exhibit 4.

J. E. Timberlake

cc: L. R. Parsons
S. A. Silverman
J. G. Harris
G. A. Bennewitz, Jr.
R. G. Buffalow

EXHIBIT 1

ELECTRO-MOTIVE

EMD GM

ADDRESS REPLY TO:
1000 JORIE BOULEVARD
SUITE 138
OAK BROOK, ILLINOIS 60521
PHONE 312-387-6710

Electro-Motive Division General Motors Corporation LaGrange, Illinois 60525 (312) 387-6000

August 11, 1983

Mr. S. A. Silverman
Purchasing Agent
Denver & Rio Grande Western Railroad Company
P.O. Box 5482
Denver, Colorado 80217

Dear Mr. Silverman:

The following is in response to your phone request for locomotive pricing for calendar year 1983. The following pricing prevails for an SD40T-2 locomotive equipped with Rio Grande modifications:

Base price for an SD40-2 locomotive	$ 894,000
Tunnel modifications	39,100
Rio Grande modifications	115,125
TOTAL	$1,048,225

Per our discussions, it is understood this pricing will be used for budget purposes.

Very truly yours,

LRBeck

L. R. Beck
District Manager
Western Region

LRB/rg

3-1-83

EXHIBIT 2

① of ③

SUMMARY QUOTATION

Denver & Rio Grande Western Railroad

SD40-2 Locomotives

This quotation lists all modifications mutually agreed upon and for which a charge is made; it supersedes all previous quotations and forms the basis for the invoice which will follow.

Modification No. **Description**

LOCOMOTIVE OPTIONS AND MODIFICATIONS

- Full service brake application from single foot pedal......................................
- Overspeed control with warning whistle, time delay, PC knockdown and suppression of service rate application........................
- Provision for service application including P2A valve and PC switch.........................
- A-1 charging cutoff pilot valve...............
- 1/2" "DL" line filters provided in actuating and independent MU lines.......................
- Brake pipe end connections with Smith vented angle ball cocks and Aeroquip 22" hoses at both ends.................................

- Air compressor synchronization with dual contact pressure switch.........................
- Salem 4 1/2" air gauges and test fittings.......
- Salem test fitting in air supply line to compressor gauge and unloader switch...........
- Two Salem 880 automatic drain valves with 872 timer actuation...........................
- Automatic timed sanding in any emergency........
- Sanding air supply taken from No. 2 main reservoir instead of No. 1......................
  MU control.................................

- MU walkway chains with bend-away walkway supports...................................
- Extended range dynamic braking with potential control only, including unit cutout switch......

- Two (2) speed dynamic brakes...................
- Grid load test feature........................

3/1/83
② of ③

- Dynamic brake grid protection....................
- 18 KW auxiliary generator - with modifications for 200 rpm operation..........................
- Low air pressure speed up circuit for two speed dynamic braking with 200 rpm low idle...........
- Barco automatic ground relay reset - Trainlined on PT #26.......................................
- Manual power reduction - trainlined, includes blocking rectifiers....................
- Faraday engine alarm buzzer......................
- 100 Amp battery charging receptacle in electric cabinet (no mating plug)...............
- Inertial blower motor failure indicating light..
- Increased capacity engine lube oil pan..........
- Young fuel oil preheater - Part No. 9517269 with Amot by-pass valve.......................
- Bolted on engine crankshaft stubshaft...........
- Engine purge control............................
- Exhaust manifold inspection port................
- Starter motor thermal overload protection.......
- Sunstrand engine temperature switches (two switches only).................................
- Mechanically bonded radiator cores..............
- Axles splined at both ends......................
- Provision for wheel truing (remanufactured journal boxes)..................................
- Traction motor bottom inspection covers (Hinged at one end and bolted at the opposite end)...................................
- Heavy duty journal springs......................
- Reinforced journal spring pockets...............
- Three Coach & Car cab seats including armrests..
- Ajax #685 water cooler with cup dispenser.......
- Pulse speed indicator/recorder with two (2) cab mounted indicators..........................
- Electric cab heaters............................
- Prime folding metal awning, Model SC977-31 both sides of cab...............................
- Salem 651-M-1 full length mirror wind deflectors, front only, both sides.............
- Bolt and hasp cab door lock in addition to basic lock......................................
- Padded sunvisor on fireman's side of cab........
- EMD large snowplow pilot - front end only.......
- Additional plate provided at long hood end - plate set 6" above top of rail.................
- NC391 draft gear and 02-E-8311 high strength coupler with alignment control - both ends......
- Translite Model 20585 DWFV signal light.........
- Microphor Model LF310 stainless steel toilet with H8 digestion tank and immersion heater includes toilet bowl heater......................
- Lifting eyes in end sheet, both ends............
- Ballast unit to 390000 lbs......................

3/1/83
③ of ③

- Two color polyurethane paint scheme.............
- Fresh charge of ARCO Supreme Lube Oil...........
- Benelex cab floor covering (3/8" thick), including two piece trap door ---------------------------
- Cab door locks with B-11 keys ----------
- Low level cooling air intake (tunnel modification)- -
- Grab iron provided at rear of long hood (curved)
- engineer's side only ---------------------------
- Lighting slots in long hood - both sides ----------
- Increased sand box capacity, 36 cu. ft. per end ---
- 4,000 gallon fuel tank including:
    - One additional fuel filter pipe on each side
    - Qualitrol fuel gauge on both side of tank
    - Gauges at 35° angle
    - Buckeye automatic fuel fill adapters -------

I

D&RGW FORM 8086
SECTION 1

DETAILED ESTIMATE

AFE No. EXHIBIT 3

Estimated Cost of Rio Grande-added modifications had Units been delivered in March 1983

Sheet No. 1 of 1 Sheets

Estimated by J. G. HARRIS Date 8-10-83 Checked by

ADDITIONS

2 3,000 H.P. DIESEL-ELECTRIC, SD TYPE LOCOMOTIVE UNITS f.o.b. BUILDERS PLANT.

BASE PRICE			
MODIFICATIONS BY BUILDER			
FREIGHT - McCOOK TO KANSAS CITY			9,000
MODIFICATIONS BY D&RGW			
COMMUNICATIONS RADIO	3,000		
RERAILERS	550		
SLING CHAINS	180		
MISC. MATERIAL	200		
FREIGHT ON MAT'L.	300		
SALES TAX	255		
TOTAL MATERIAL	4,485		
STORE EXPENSE	449		
SHOP EXPENSE	119	5,053	
LABOR - MECHANICAL	500		
- COMMUNICATIONS	150		
SHOP EXPENSE	83		
R&E OVERHEADS	349	1,082	6,135

TOTAL COST ONE (1) LOCOMOTIVE UNIT

TOTAL COST LOCOMOTIVE UNITS.

DR R&E ACCOUNT #52

Rec'd 8/12 [illegible]

EXHIBIT 4

PCF
Pacific Car and Foundry Company
1400 NORTH 4TH STREET, RENTON, WASHINGTON 98055 • (206) 251-7700
A DIVISION OF
PACCAR

August 9, 1983

Mr. S. A. Silverman
Purchasing Agent
Denver & Rio Grande Western Railroad Co.
P.O. Box 5482
Denver, Colorado 80217

Subject: Budgetary Price - Cabooses

Dear Mr. Silverman:

In accordance with our conversation and your request, we offer the following information for your consideration.

Our most recent caboose quotation factored to reflect current pricing suggests a budgetary figure in the range of $94,000 each.

The base quotation covered 25 fully equipped cabooses meeting the latest FRA and OSHA requirements.

Obviously, without specifications and quantities it is impossible to give a definitive answer to your question.

Mr. Silverman, we hope the above budgetary figure will be of value to you.

Sincerely,

PACIFIC CAR AND FOUNDRY COMPANY
Division of PACCAR Inc

D W Paul
Don W. Paul
Regional Sales Manager

DWP/bt

August 10, 1981

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
R. J. Elston
J. J. Donohue
C. H. Smith

Subject: Update of SD-40T-2, GP-40-2, and caboose costs for costing and rate making use.

Mr. Silverman was requested to secure new cost estimates for locomotives and cabooses and has come up with the following:

	First half of '82 delivery	Second half of '82 delivery
SD-40T-2		
Base Price	$872,400	$948,260
Modifications & Extras	139,075	151,168
	$1,011,475	$1,099,428

I suggest your using $1,105,000 as the cost of an SD-40T-2.

	First half of '82 delivery	Second half of '82 delivery
GP-40-2		
Base Price	$746,700	$811,630
Modifications & Extras	105,100	114,239
	$851,800	$925,869

I suggest your using $931,000 as the cost of a GP-40-2.

Caboose

10 car order basis	$81 - 83,000

Suggest you use $83,000 as the cost in your calculations.

J. E. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy

August 10, 1981

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
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Caboose

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J. E. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy
bcc: ✓Loco.file
Equip. file

Mr. S. A. Silverman 7-22-81

Locomotive Pricing
Second half 1982

		Firm 1st half '82	Estimated 2nd half '82 (8%)
GP40	Base Price	746,700	811,630
	Modifications	105,100	114,239
	Total	851,800	925,869

		1st half '82	Estimated 2nd half '82 (8%)
SD40-2T	Base	872,400	948,260
	Modif.	139,075	151,168
		75	1,099,428

L.K. Beck

NOTES

7/20/81

10 cabooses

$ 81-83000

Mid-1982

ex Silverman

The A.B. Hirschfeld Press Denver 320-8500

NOTES

7/20/81

10 cabooses

$81-83000

Mid-1982

ex Silverman

The A.B. Hirschfeld Press Denver 320-8500

Mr. S. A. Silverman 7-22-81

Locomotive Pricing
Second half 1982

		Firm 1st half '82	Estimated 2nd half '82 (8%)
GP40	Base Price	746,700	811,630
	Modifications	105,100	114 239
	Total	851,800	925,869

		1st half '82	Estimated 2nd half '82 (8%)
SD40-2T	Base	872,400	948,260
	Modif.	139,075	151,168
	Total	1,011,475	1,099,428

L.R. Beck

February 11, 1981

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
R. J. Elston
J. J. Donohoe

Subject: Update of SD-40T-2 and GP-40-2 locomotive costs for cost and rate purposes.

In late December Mr. Silverman secured the following cost information on new SD-40T-2 and GP-40-2 power for me.

Estimated last half 1981 costs of an SD-40T-2 and a GP-40-2 meeting Rio Grande specs and equipped with Rio Grande options are:

SD-40T-2

$837,200	base price
150,000	Rio Grande options and extras
$987,200	Total

Suggest you use $995,000 per unit as SD-40T-2 costs in your calculations.

GP-40-2

$718,000	base price
150,000	Rio Grande options and extras
$868,000	Total

Suggest you use $875,000 per unit as GP-40-2 costs in your calculations.

J. B. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy

February 11, 1981

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
R. J. Elston
J. J. Donohoe

Subject: Update of SD-40T-2 and GP-40-2 locomotive costs for cost and rate purposes.

In late December Mr. Silverman secured the following cost information on new SD-40T-2 and GP-40-2 power for me.

Estimated last half 1981 costs of an SD-40T-2 and a GP-40-2 meeting Rio Grande specs and equipped with Rio Grande options are:

SD-40T-2

$837,200	base price
150,000	Rio Grande options and extras
$987,200	Total

Suggest you use $995,000 per unit as SD-40T-2 costs in your calculations.

GP-40-2

$718,000	base price
150,000	Rio Grande options and extras
$868,000	Total

Suggest you use $875,000 per unit as GP-40-2 costs in your calculations.

J. E. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy

✓ bcc Locomotive file

September 19, 1980

Messrs: H. E. Cash
R. C. Hagaman
R. S. Powers
P. D. Smith
C. H. Smith

Subject: Update on new caboose costs for cost and rate purposes.

This supplements my letter of September 4 updating prices on GP-40 locomotives.

Mr. Silverman has received a price quote from Pacar of $73,500 per caboose if bought in quantity today, and an estimate of $76,000 per car if bought next year.

Suggest you use $76,000 per car as caboose costs in your costing work.

J. E. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy

bcc: GGIV
[✓ Locomotive file]

September 4, 1980

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
R. S. Powers
P. D. Smith
C. H. Smith

Subject: Update of GP-40-2 locomotive costs for cost and rate purposes.

As information, latest cost dope on GP-40-2 units, secured by Mr. Silverman at my request, should be used in costing those systems where GP-40-2's may be required for helpers or for primary power.

Estimated first half 1981 cost of a GP-40-2 unit meeting Rio Grande specs and equipped with Rio Grande options is:

$666,400	base price
98,355	Rio Grande options and extras
$764,755	Total

Suggest you use $770,000 per unit as GP-40-2 cost in your calculations.

Have requested but not yet received update on cabooses.

J. E. Timberlake

cc: A. H. Nance
L. R. Parsons
J. E. Clancy

bcc: Gravel Gertie IV
Locomotive file

rate purposes.

ed by Mr.
e systems
nary power.

Rio Grande

our

3/23/78

JCT

SAS advises as follows:

GP 40-2

$485,000 - Base
$ 50,000 - add-ons

$535000
Say $540M
Fall 78'

RDC 8:40 a

12/1/78

Beck's estimate of price differential
for basic locomotives (w/o RG modifications) for last $\frac{1}{2}$ 79 dlvy

Basic Engine

534200 – GP-50 if available last $\frac{1}{2}$ 79 = $ 590,000
SD-50 last $\frac{1}{2}$ 79 = 685,000

Beck says they're engineering a tunnel
modification for GP-50's

SD 50 66M# TE @ 17 mph -
SD 40 - 66M# TE @ 15 mph -
X GP40X(50) 66M# TE @ 7 mph -

SD-50 @ 12 mph = 86M# TE
SD-40 @ 12 mph = 77M#
~~SD-45 @ 12 = 77M#~~

4,743,200

4 SD-40

5 SD - 385 -
4 SD 50 = 344

4X125000 = $500,000

8000

59 X 133 + 42

GP-50 = 2000 act/unit
down 2%

SD-50 = 3000 act/unit
down 2%

1600 (4)

DIGITIZED 13 JANUARY 2022

5 SD-X

Nov 78
Around
Back

3500 horse GP-50

last ½ 79 GP-40 ~~Dec~~ Dec 79 534200
SD-40 Dec 79 624700

+25M-30M for wheelslip for engine
+ inflation

1980—

Midyr 1980

GP
GP

98M at 0—7mph
88M at 8½mph

S
00M @ 8mph

S
45M @ 0-7mph
44M @ 7-12mph

SD-
o tons—

GP-4
o Tons+
o tons

5 SD-X

5

GP-40 with X range 40M lbs braking' - TE
GP-50' with ——— 40M+ = abt 41M bkg. TE 98M at 0 – 7mph
88M at 8½ mph

—

SD-40 with X range 60M Bkng. TE 100M @ 8mph

SDX 59 – 60M TE 145M @ 0 - 7mph
144M @ 7 – 12mph

SD = 3000act/unit on 2%
GP-40 = 2000/unit on 2%

4 units = 12000 Tons -
4 units = 8000 Tons +
5 units = 10 000 tons

JET

cc DJB
RGB
FAR

ELECTRO-MOTIVE

EMD GM

Electro-Motive Division General Motors Corporation LaGrange, Illinois 60525 (312) 387-6000

November 6, 1978

Mr. J. E. Timberlake
Director Unit Train Operations
Denver & Rio Grande Western Railroad Co.
1515 Arapahoe Street
P.O. Box 5482
Denver, Colorado 80217

Dear Sir:

At the request of L. R. Beck, attached are two copies each of Speed-Tractive Effort Curves SC3031 and SC3033. These curves represent the characteristics of the GP50 and SD50 locomotives respectively equipped with 70:17 gearing and 40 inch diameter wheels. The same curves apply to units equipped with 62:15 gearing.

At the present time these are the only characteristic curves available and it is hoped that they will fill your immediate needs.

Sincerely,

E H Lindberg

E. H. Lindberg
Product Application

EHL:mt
encl:
cc: L. R. Beck

cc DJB
RGB
FAR

3

ELECTRO-MOTIVE

EMD GM

Electro-Motive Division General Motors Corporation LaGrange, Illinois 60525 (312) 387-6000

November 8, 1978

Mr. J. E. Timberlake
Director Unit Train Operations
Denver & Rio Grande Western Railroad Co.
1515 Arapahoe Street
P.O. Box 5482
Denver, Colorado 80217

Dear Sir:

Supplementing my letter of November 6, 1978, attached are two copies each of DP535 and SC2911 showing the dynamic brake characteristics of the GP50 and SD50 locomotives. The SD50 will be equipped with the same braking equipment as the present SD40-2.

Sincerely,

E. H. Lindberg

E. H. Lindberg
Product Application

EHL:mt
encl:
cc: L. R. Beck

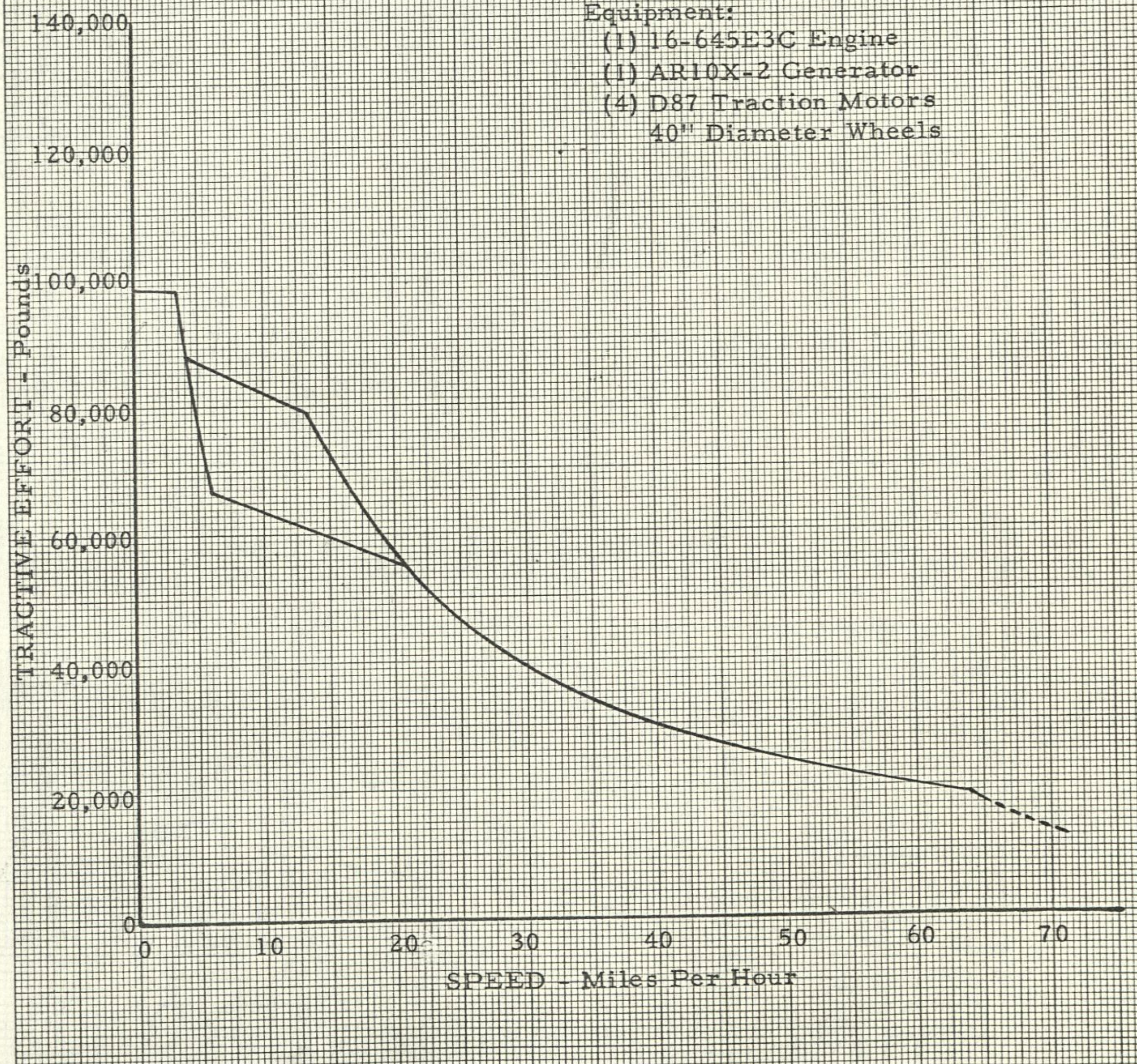
1981

2

12/6/77

Electro-Motive Division
General Motors Corporation
LaGrange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3500 HP Model GP40X Locomotive
70:17 Gear Ratio



Equipment:
(1) 16-645E3C Engine
(1) AR10X-2 Generator
(4) D87 Traction Motors
40" Diameter Wheels

SC 3031

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

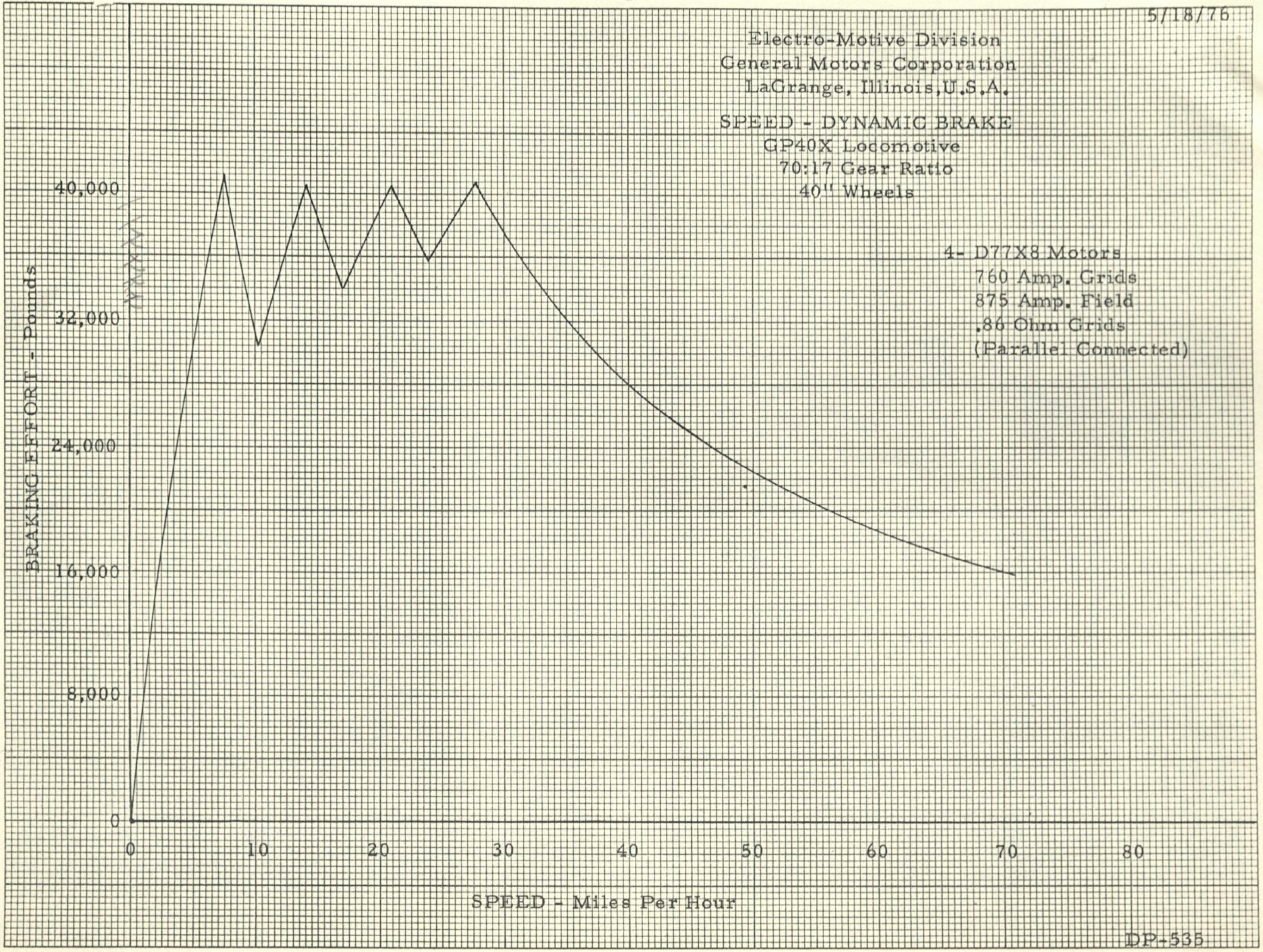
EUGENE DIETZGEN CO.
MADE IN U. S. A.

5/18/76

Electro-Motive Division
General Motors Corporation
LaGrange, Illinois, U.S.A.

SPEED - DYNAMIC BRAKE
GP40X Locomotive
70:17 Gear Ratio
40" Wheels

4- D77X8 Motors
760 Amp. Grids
875 Amp. Field
.86 Ohm Grids
(Parallel Connected)

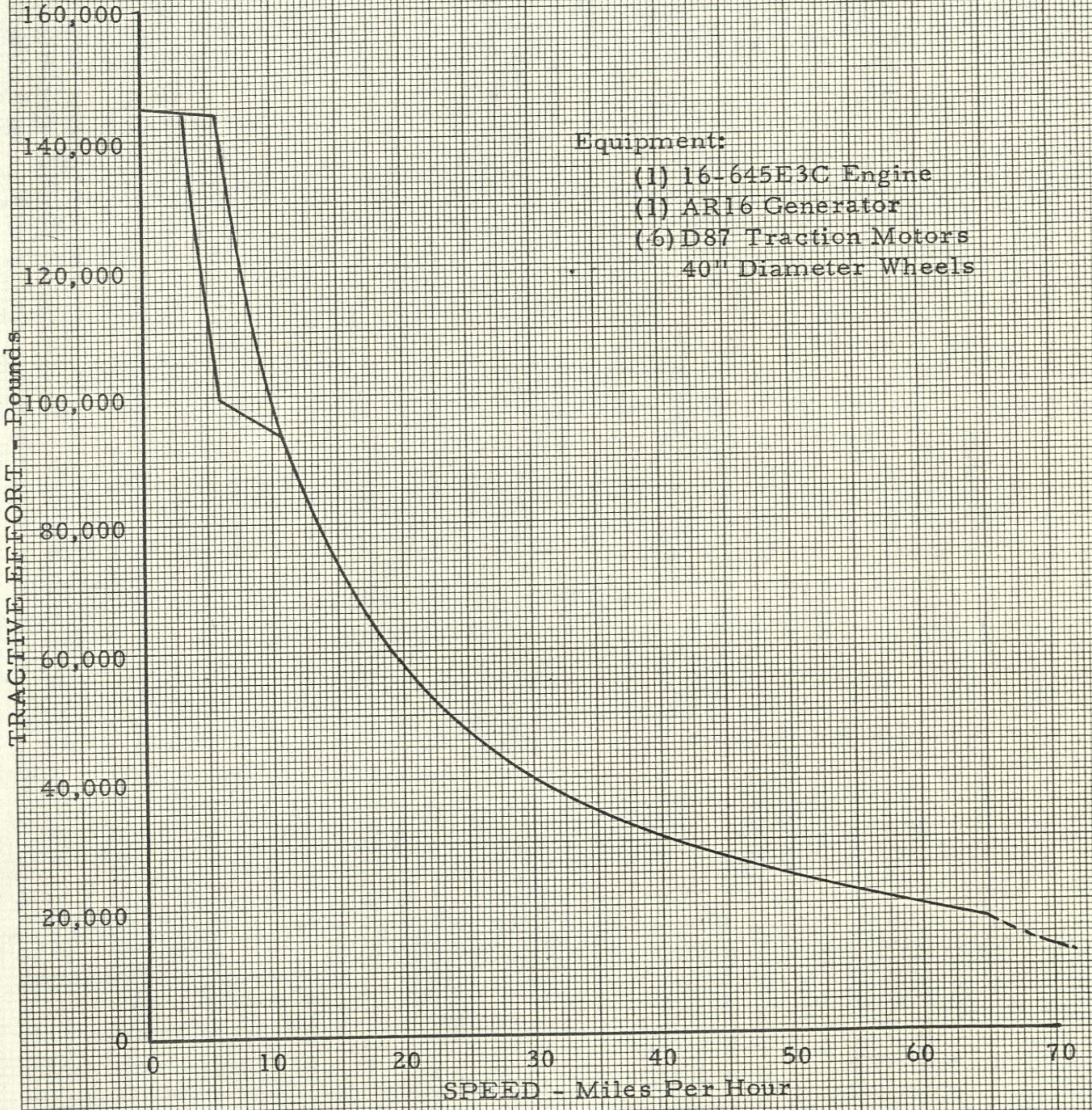


DP-535

12/6/77

Electro-Motive Division
General Motors Corporation
LaGrange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3500 HP Model SD40X Locomotive
70:17 Gear Ratio



Equipment:
(1) 16-645E3C Engine
(1) AR16 Generator
(6) D87 Traction Motors
40" Diameter Wheels

SC 3033

NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER
EUGENE DIETZGEN CO.
MADE IN U. S. A.

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

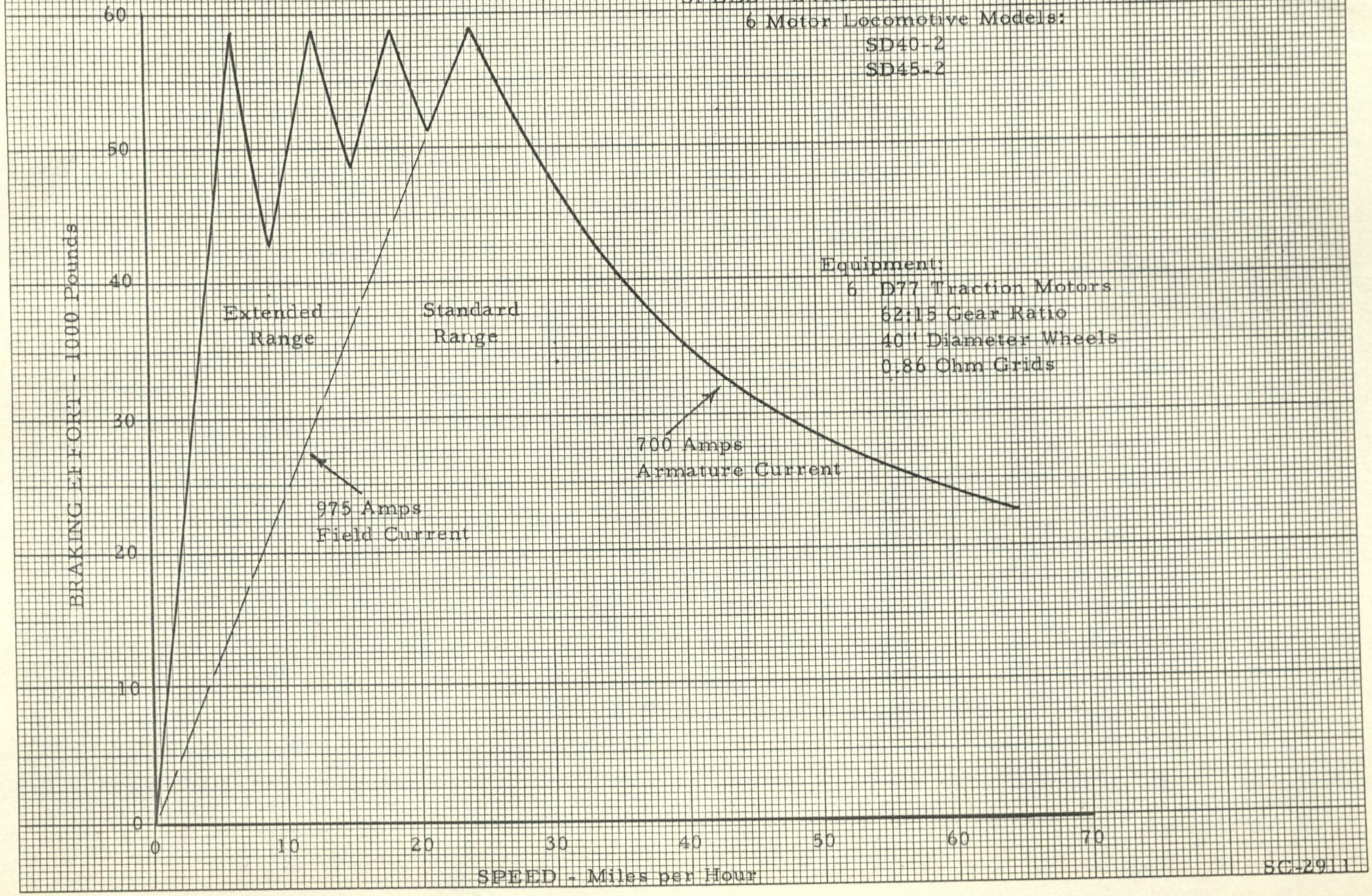
4-21-72

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - DYNAMIC BRAKING EFFORT

6 Motor Locomotive Models:
SD40-2
SD45-2

Equipment:
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels
0.86 Ohm Grids



SC-2911

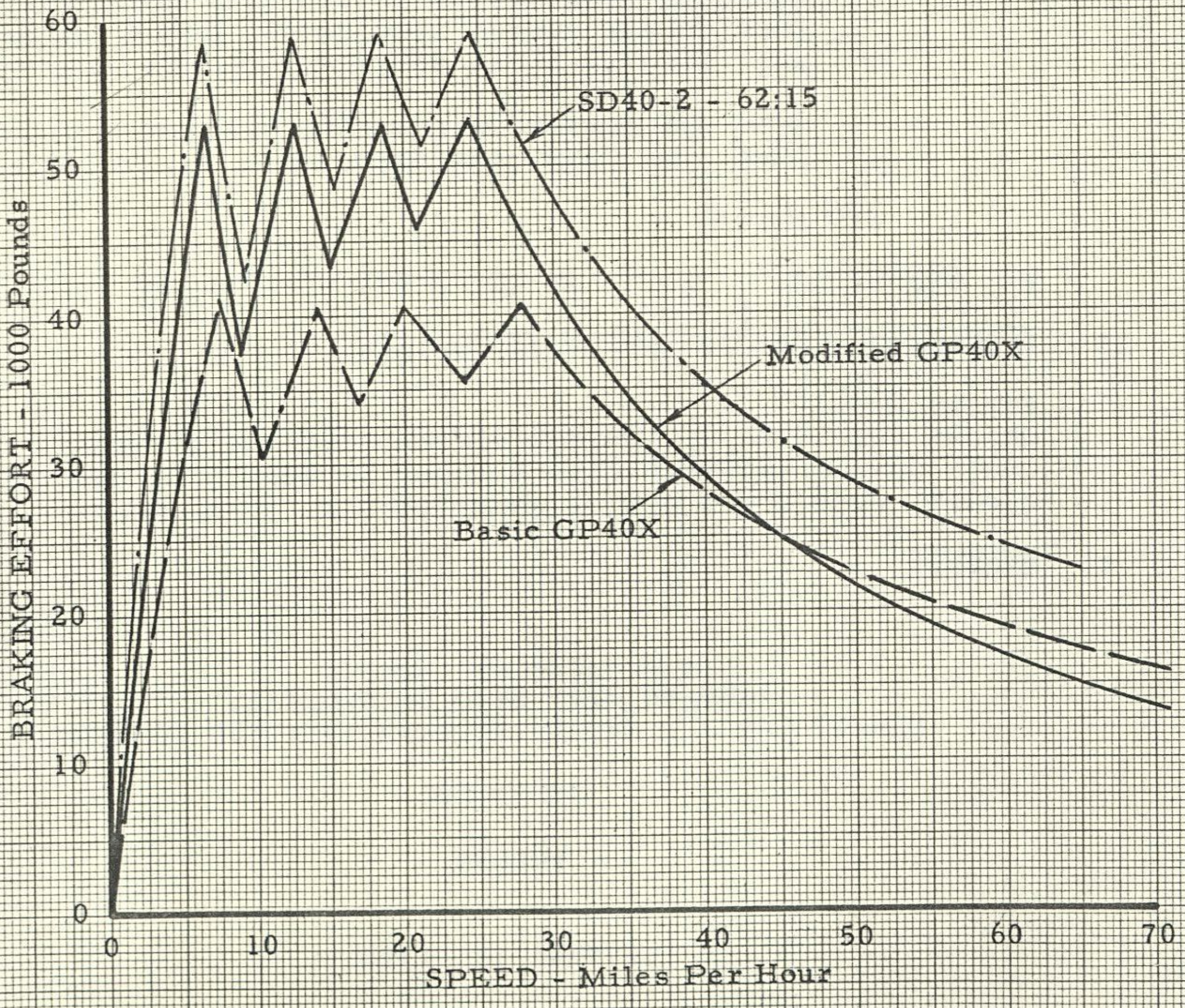
11/5/79 ex Bob Beck

5/12/77

Electro-Motive Division
General Motors Corporation
LaGrange, Illinois, U.S.A.

SPEED - DYNAMIC BRAKING EFFORT COMPARISON

GP40X - 70:17 G.R. - 40" Wheels
Basic & Higher Capacity Modification
SD40-2 62:15 - 40" Wheels



DP 623

NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

EUGENE DIETZGEN CO.
MADE IN U. S. A.

1981

ELECTRO-MOTIVE
Division of General Motors Corporation
La Grange, Illinois 60525

January 16, 1980

AGENDA

covering

DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY
SIXTEEN (16) GP50 LOCOMOTIVES
EMD ORDER NO. 806001

70:17 = 62:15

I. GENERAL

General Motors Locomotive Specification 8112, covering the basic 3500 horsepower GP50 locomotive model, is amended by mutual agreement to include options and modifications detailed below.

II. LOCOMOTIVE OPTIONS AND MODIFICATIONS

A. AIR SYSTEM

same as SD 40 thruout part A

1. Air Brakes

   a. Basic 26L brake equipment with "F" control valve, with the following features and modifications:

   b. Full service brake application with warning whistle, four to six second time delay, and PC knockdown provided from single 9 inch wide dead man foot pedal.

   c. Overspeed limit with warning whistle, time delay and PC knockdown provided. Includes suppression of service application.

      1. Overspeed limit set for 75 mph.

   d. Provision for service application including P2A valve and PC switch.

   e. A-1 charging cutoff pilot valve, including two No. 8 vent valves, controls the following functions:

      1. Power knockdown from any emergency - trainlined.

A. AIR SYSTEM

1. Air Brakes (Continued)

e. 2. Brake pipe break-in-two.

f. Air End Connections

1. Basic duplex air end connections.
2. Aeroquip MU hoses at both ends on one side of coupler only.
3. Brake pipe located on right hand side of coupler when facing end plate both ends.

g. Other air brake modifications:

1. Independent brake valve control pressure set for 90 psi on the gauge.
2. Removable offset independent brake valve handle.
3. Removable automatic brake valve handle.
4. Emergency brake valve in cab provided basically.
5. Provision for compatible operation with locomotives equipped with 6BL brakes not provided.
6. Smith vented ball-type cutout cocks.
7. J1.8-18Proportioning valve (180% relay valve) is provided.
8. Apply street L with proper choke on forward side of exhaust port exhausting downward on automatic drain valve.
9. Independent valve to have threaded hole and 2" pipe nipple to exhaust inside control stand.
10. ½" "DL" line filters are provided in the actuating and independent MU lines.

2. Air Compressor

a. Basic 3-cylinder water cooled WBO compressor.

b. Air compressor synchronization with dual contact pressure switch.

c. Filter is Air Maze.

A. AIR SYSTEM

2. Air Compressor (Continued)

   d. Other air compressor modifications:

      Gauge must be magnetic coupling type.

3. Gauges & Fittings

   a. Salem 4½" air gauges - green dial.

   b. Basic complement of four test fittings in air gauge manifold and a fifth fitting in the air supply line to the main reservoir pressure gauge and compressor unloader switch.

4. Main Reservoir

   a. Filters

      Basic Salem 818 and 824 centrifugal filters located after the No. 1 and No. 2 main reservoirs, filter air for the auxiliaries and the air brake respectively.

   b. Drain valves and actuation

      1. Salem 880 automatic drain valves on both main reservoirs.

      2. Actuation of filters and drain valves.

         Blow-down of filters and automatic drain valves is actuated by Salem 872 timer at one (1) minute intervals.

   c. Other Main Reservoir Modifications:

      1. None Provided.

5. Warning Devices

   a. Bell

      Basic application.

   b. Horn

      Basic Leslie SL horn, mounted at basic location on centerline of the cab roof with two bells facing forward and one rearward. (8" total height including mounting).

Same as SD-40

A. AIR SYSTEM

5. Warning Devices (Continued)

c. Other warning devices (air controlled)

1. None provided.

End of Part A

B. SANDING

1. Control

a. Basic inboard-outboard sanding.

b. Basic electric control only. Assignment of trainline control wires covered under C.2.a. below.

c. EMD Super Series wheel slip control system utilizes electronic ground speed indication and a controlled wheel creep concept providing improved locomotive adhesion capability.

d. Automatic sanding initiated in brake valve handle emergency position is basic.

2. Switches & Lights

a. Manual (directional) sanding switch is basic non-latching type.

b. Lead axle sanding switch is basic latching type. An indicating light is provided to show all sanding conditions, except wheel slip sanding.

3. Sand Traps and Related Devices

a. A total of eight (8) basic 273 sand traps including integral rotary shutoff valve is provided.

4. Sand Box Capacity

a. Capacity

Smaller than SD40 Basic sand box capacity of 20 cu. ft. both ends.

5. Other Sanding Modifications

a. Automatic sixty-second timed sanding from any emergency.

b. Sanding air supply taken from No. 2 main reservoir instead of No. 1.

B. SANDING

5. Other Sanding Modifications (Continued)

c. Sanding directional control and emergency per AAR standards.

C. MULTIPLE UNIT CONTROL

Multiple unit control is provided. The following modifications/features are provided:

1. Cables

a. One twenty-seven point EMD jumper cable nine (9) feet long.

2. Receptacle

a. 1. Single twenty-seven point Pyle-National WWRF27K receptacle at each end.

   2. Standard AAR pin assignments.

   3. Receptacle is located in end plate at both ends.

3. Walkway Ramps

Fixed walkway ramp provided at front end of locomotive.

4. Other MU Modifications

a. MU safety chains are mounted on separate support posts, both ends of locomotive with hangers.

D. DYNAMIC BRAKES

1. Extended range dynamic brakes with the following features and modifications:

   Use modified 800 amp dynamic

   a. Two (2) speed Dynamic brake not provided.

   b. Standard potential control trainlined on #24 wire.

   c. Standard EMD system in which braking effort is regulated by motor field excitation current -- i.e., with any given position of control handle, braking effort increases as speed increases up to the 700 amp maximum.

D. DYNAMIC BRAKES

2. Interlock

PC switch used for Type II, non-reapplying interlock, i.e., the locomotive brake will not reapply after release of a dynamic brake application which had earlier caused release of an automatic service application. The independent air brake function is not affected by the dynamic brake interlock.

3. Load Test Provision

Provision is made for load testing locomotive on its own dynamic brake grids.

4. Grid Protection Circuit

Special circuit is provided to nullify dynamic brake in response to grid blower motor failure.

5. Ground Relay Protection

No special dynamic brake ground relay protection is required.

6. Other Dynamic Brake Modifications

a. DBI solenoid located on brake valve side of dual-ported cutout cock.

b. D&RGW special dynamic brake cutout switch circuitry.

c. Air system is modified to provide individual unit bleed-off of dynamic brake interlock per D&RGW drawing, dated December 14, 1972.

E. ELECTRICAL CONTROL MODIFICATIONS

Motors are permanently connected in parallel. No motor shunting is required.

1. Batteries

All sixteen (16) units have Exide UD-466 unitized batteries.

2. Auxiliary Generator

Basic 18 KW AC auxiliary generator provided.

E. ELECTRICAL CONTROL MODIFICATIONS (Continued)

3. Traction Motor Cut-outs

No provision is made for locking out individual motors.

4. Ground Relay Reset

Barco/Summit automatic ground relay reset replaces the basic reset. This system resets the ground relay automatically six to ten seconds after each occurrence, and locks out (i.e., does not reset automatically) if four grounds occur within 30 minutes. If grounds do not repeat with regularity, the device "erases" earlier grounds and resets the count to zero.

a. Reset for the automatic device is located in the electrical cabinet.

b. Basic manual reset button is retained on control stand.

c. Ground relay reset is trainlined to AAR standard.

5. Other Electrical Control Modifications

a. Manual power reduction trainlined per AAR standards; three-position switch off MU single -- add blocking rectifiers per customer's sketch.

b. Faraday alarm buzzer located bottom right side of control stand (outside of control stand).

c. 100 amp battery charging receptacle provided in electrical cabinet.

F. ENGINE MODIFICATIONS

1. Filters

a. Primary (carbody) filters

1) Basic inertial separator, providing filtered air to engine filter and generator-motor blower. Customer specifically requires AAF elements.

2) Inertial blower motor protection

Basic circuit breaker prevents motor overload. Indicating light on engine control cabinet indicates tripped circuit breaker resulting from motor overload condition.

F. ENGINE MODIFICATIONS

1. Filters

b. Engine air filters

AAF fiberglass "bag-type" engine air filters provided basically.

c. Other filter modifications

None Provided.

2. Oil Pan Capacity

Oversize oil pan increases lube oil capacity to 396 gallons.

3. Engine Turning Jack

None provided.

4. Fuel Oil Preheater

Large EMD preheater system provided, includes Young heat exchanger, P/N 9517269. Preheater is mounted on accessory rack and piped into pressure side of fuel pump.

5. Bolt on Stubshaft

Bolted-on accessory end engine crankshaft stubshaft provided.

6. Other Engine Modifications

a. Engine Purge control system.

b. Exhaust manifold inspection port is provided.

c. Low engine idle speed is basic.

d. No spark arresting manifold is required in conjunction with turbocharged engine exhaust emissions.

e. Low water - high crankcase pressure engine shut down device provided basically with 20 psi pressure cap.

f. Turbocharger screen assembly includes basically, a trap box attached to the outer body at the at the bottom which collects small debris.

G. TRUCKS

1. Basic single shoe flexible truck design with the following features and modifications:

2. Wheel/Axle/Gear

    a. Gear Ratio

    Diff from SD →

    70:17 gear ratio provides full horsepower to 63 miles per hour and a minimum continuous speed of 9.8 miles per hour.

    b. Axles

        1. Axles with 6-7/8" journal diameter provided basically.

        2. Axles splined at both ends.

    c. Wheels

        1. Forty-inch D-40 wrought steel wheels with AAR contour. Machined witness groove is basic Class BR wheels.

3. Journal Boxes

    a. Hyatt JEM journal boxes, new only, applied basically.

    b. Oil fill cups

    Plugs replace basic JEM quick-fill oil cups.

4. Brake Rigging

    a. EMD pin type.

5. Huck Fasteners

    Not used in truck construction.

6. Traction Motor Modifications

    a. Traction motor bottom inspection covers are hinged at one end and bolted at the opposite end.

    b. Provide traction motor support bearing seal rings.

G. TRUCKS (Continued)

7. Other Truck Modifications

a. Grind relief on all corners of journal box guides.

H. CAB MODIFICATIONS

1. Cab Seats

a. One Coach and Car (1291702-D) slide-rail-mounted cab seat with backrest and armrests is provided at engineer's position.

b. Two Coach and Car slide-rail-mounted cab seats are mounted on the observer's side and include the following:

1) Padded armrests.

2) Special seat cushion material.

3) Special seat cushion contour (front radius is greater than rear radius).

4) Dark green color.

c. The three cab seats are equipped with D&RGW monograms.

2. Water Cooler

a. Ajax #685 water cooler (includes two gallon basic bottle).

b. Dixie 1444-S cup dispenser.

3. Speed Indicator/Recorder

Can be CP as on SD-40 — May change to LCD

Barco Model DPC-85 mechanical speed indicator/ recorder with overspeed switch grease lubrication -- 0-85 mph, black face dial with keys. Recorder cable to be on right side.

4. Temperature Control

a. Electric cab heaters (10.1 KW) replace basic hot water units. Application requires that 18 KW auxiliary generator be applied.

b. The switch controlling the right side strip heater is a round knob so that engineer can distinguish strip heater switch from the headlight switch at night.

H. CAB MODIFICATIONS (Continued)

5. Cab Flooring

Rough surface 3/8" thick Benelex covering the plywood base, includes two piece trap door.

6. Awnings

Prime folding metal awning Model SC977-31 on both sides of cab.

7. Wind Deflectors

Salem 651 wind deflectors front only on both sides. Mirror is full length.

8. Doors, Windows, Glass

a. Cab door lock identification. Same as last D&RGW order 786264.

b. Window Glass

  1) Lexgard railaminate 3/8" thick glass for sliding cab windows, both sides.

  2) Elcon National Triplex "Y" glazing replaces basic glass in all front and rear cab windows.

9. Controller

Basic AAR-approved "three-handle" arrangement with separate controls for power and brake.

10. Other Cab Modifications

a. Basic zero - center ammeter indicates motor amps under power with clockwise deflectors from the "zero - center" position and braking current with counter-clockwise deflections.

b. Phase II AAR/EMD clean cab is provided basically.

c. Padded sunvisor required on Fireman's side of cab as well as basic on engineer's side.

I. RADIO

1) No radio or provision is provided by EMD.

J. CARBODY

1. Basic low profile short hood.

2. No. 1 front end arrangement.

   a. EMD large snowplow pilot part number 8475665 less doors.

   b. Sidestep

      24" side footboards with 15" bottom step clearance and including side footboard lights and side uncoupling arrangement are basic.

      This design meets FRA requirements for locomotives regularly assigned to switching service.

3. No. 2 rear end arrangement

   a. Basic pilot/hose storage rack assembly - not required - flat plate only - no slots - bottom of plate 6" above rail.

   b. Sidestep

      24" side footboards with 15" bottom step clearance and including side footboard lights and side uncoupling arrangement are basic.

      This design meets FRA requirements for locomotives regularly assigned to switching service.

4. Coupler/draft gear

   Basic HTE 8311 NC391 draft gear and "E" coupler with alignment control at both ends.

5. Lights

   a. The basic complement of lights, specifically including twin sealed beam headlights at both ends and side footboard lights at all four (4) corners is supplemented with the following lights and lighting modifications:

      1. Translite Model 20585 DWFV twin-sealed beam white signal light, including inching feature, provided in low short hood. Slow oscillation is provided.

J. CARBODY (Continued)

6. Fire Extinguishers

Basic complement, consisting of two 20 lb. Ansul dry powder extinguishers, one in the cab, the other in the engine compartment.

7. Toilet

a. Microphor Model LF310 plastic toilet with integral sequence and H8 digestive system, including chlorinator, water tank, and immersion heater. The following EMD part numbers apply:

Treatment system including chlorinator - 8484976, 8484977, 8484978, 8484979, 8484980, 8484981 and 8484982.

b. Heating with control for under toilet bowl - See customer's sketch for details.

8. Lifting and Jacking Devices

a. Jacking pad/cable sling

Basic arrangement only, consisting of one combination sling/jacking pad welded to the underframe side sill, near the longitudinal bolster center.

b. Supplemental lifting eyes

Lifting eyes in end sheet are provided, both ends.

9. Locomotive Weight

a. Nominal loaded weight including all modifications and supplies is 276,500 pounds. The standard manufacturing tolerance may result in a plus or minus 3,500 pound variation from the nominal weight. Variation between trucks does not exceed 3,500 pounds.

b. Locomotive scale weight record, EMD form 420D, to be furnished for each locomotive.

10. Clearance

a. Height

No special height restrictions.

J. CARBODY (Continued)

11. Other Carbody Modifications

a. Low level cooling air intake (tunnel modification) with 20 psi pressure cap ~~(stronger clips on cooling fan guards)~~.

b. Handrails follow contour of platform on No. 2 (rear) end and are positioned 2-3/8" inboard of the platform edge.

c. Offset provided inside underframe-mounted handrail adjacent to rear ladder steps, both sides of locomotive.

d. Curved horizontal grab iron provided at rear of long hood, engineer's side only. Grab iron extends from side of long hood around to rear and is at same height as underframe-mounted handrails.

e. Slot provided inside of long hood at No. 2 end (rear) ladder steps, both sides of locomotive.

NOTE: Slots permit light from the basic rear end platform lights to illuminate the ladder steps.

f. Type "F" glad-hand connections replace the basic "rattlesnake" connections for water fill at the following two locations:

1) Cooling system water fill.

2) Toilet water fill, both sides of locomotive.

g. Basic steplights in place of ground lights.

K. FUEL TANK

1. Description

a. Capacity

4000 if possible

Maximum fuel tank provides 3,600 gallon capacity.

b. Filler Pipes

Two filler pipes located on each side of tank.

c. Gauges

1. Basic full length sight glass, both sides. Qualitrol dial-type gauges, both sides. Gauges to be located at 35° angle same as Southern Pacific.

K. FUEL TANK

1. Description

c. Gauges (Continued)

2. One eight-inch fill gauge adjacent to each basic filler pipe, i.e., total of two.

d. Automatic Fuel Fill Adapters (Shutoff Device)

Buckeye adapter with external G-1620-103. Adapter to be provided. See customer's sketch for details.

e. Retention tank not provided.

2. Other Fuel Tank Modifications

None provided.

L. STYLING AND PAINTING

1. In accordance with drawings prepared by EMD and approved by D&RGW. Similar to previous order # 786264.

2. Paint

a. Exterior

All exterior carbody surfaces painted with a two color polyurethane paint scheme consisting of the following colors:

1. Black

2. Orange

b. Exterior

Lower Locomotive: Basic enamel paint provided on the fuel tank air reservoirs, trucks and other undercarriage surfaces in the following colors:

1. Black

c. Cab interior is painted with basic suede gray.

d. The interior of the short hood, long hood and components is painted with basic suede gray.

L. STYLING AND PAINTING

3. Decorative Pressure Sensitive Markings

a. None Required.

4. Identification

a. A stenciled "F" is located on the side sill near the end of each side to identify the short hood end as the front.

b. Number Boxes

Number panels are of fiberglass construction and include white on black.

c. Road and Serial Numbers are as follows:

ROAD NUMBERS	SERIAL NUMBERS
Open through Open	806001-1 through 806001-16

d. Other Identification Modifications

1. None required.

5. Other Styling and Painting Modifications

a. Horn will not be painted.

b. Anti-glare pattern not provided on top of short hood.

c. Special roof and deck coatings not provided.

M. SHIPMENT

1. Consignment and Routing

In accordance with written instructions furnished by railroad.

2. Operating Supplies

M. SHIPMENT

2. Operating Supplies (Continued)

Locomotives are shipped with full complement of Arco GL Supreme lube oil if available at the time of delivery.

N. DRAWINGS

Standard set of drawings provided.

1. Half size Mylar (to be 4 mil - double matte) of the following:

   a. Physical schematic wiring diagram.
   b. Cable and conduit layout.
   c. Wire running list.
   d. Setting chart.
   e. Schematic air piping.

2. Full size sepia of remainder.

NOTE: The physical schematic wiring diagram, the cable and conduit layout and the location diagrams of the wire running list are on one drawing. (See sample drawing from customer)

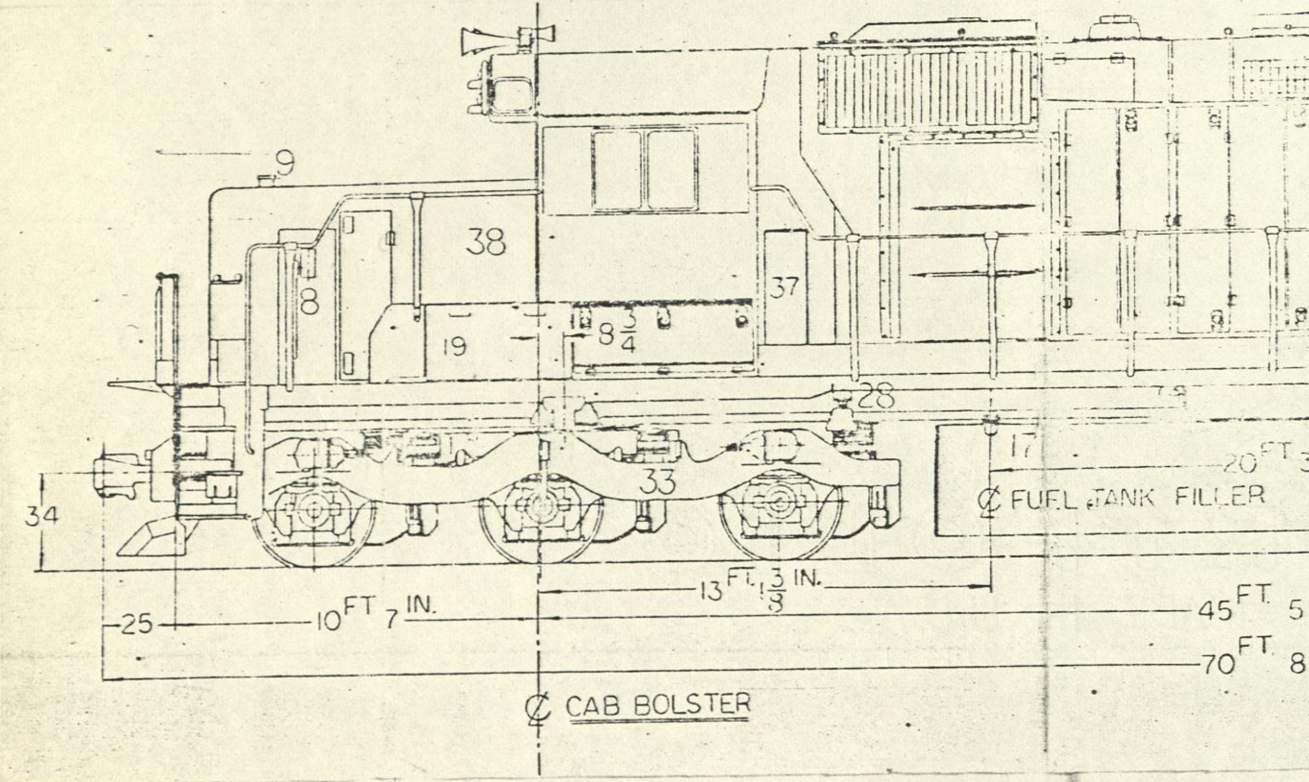
O. SPECIAL INSTRUCTIONS

a. Wording for cab cards is as follows:

Operator	DENVER AND RIO GRANDE WESTERN
Owner	DENVER AND RIO GRANDE WESTERN
Code No.	0280

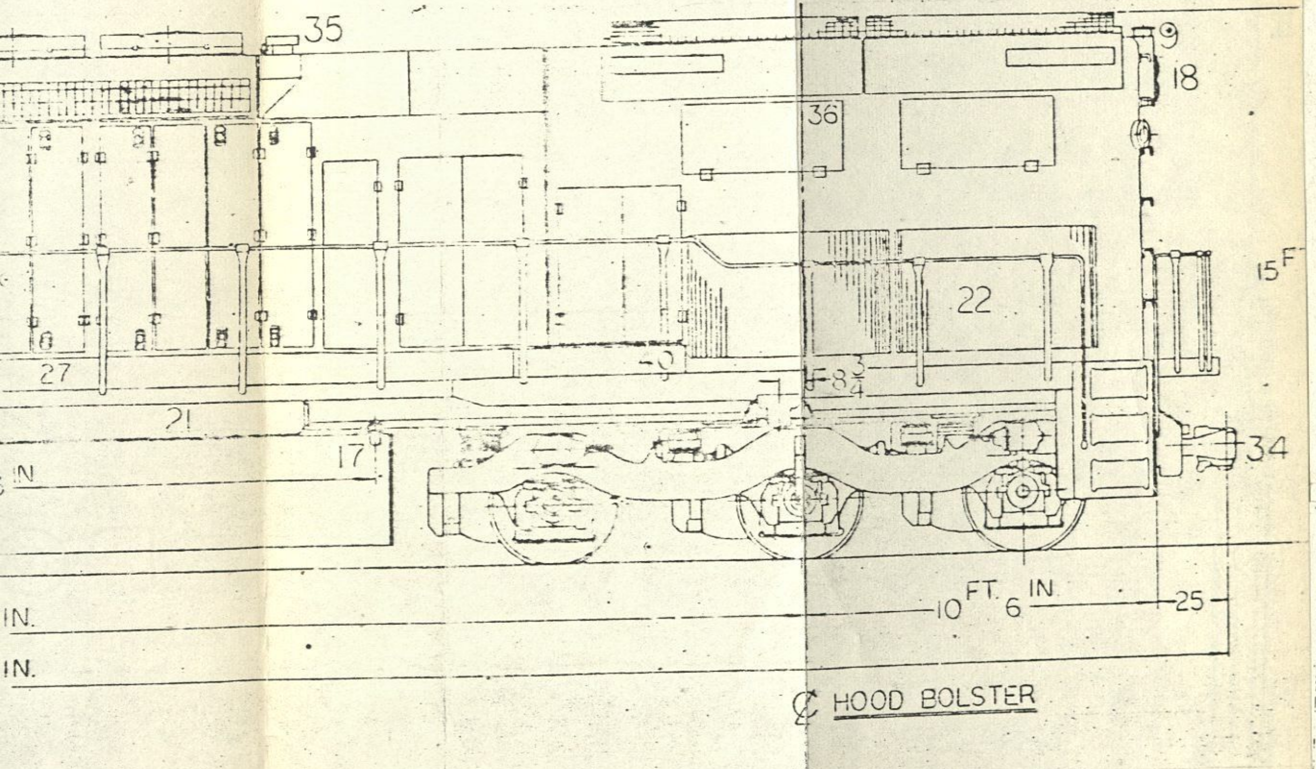
J.E. Schnabel
Sales Engineering

JES:vad

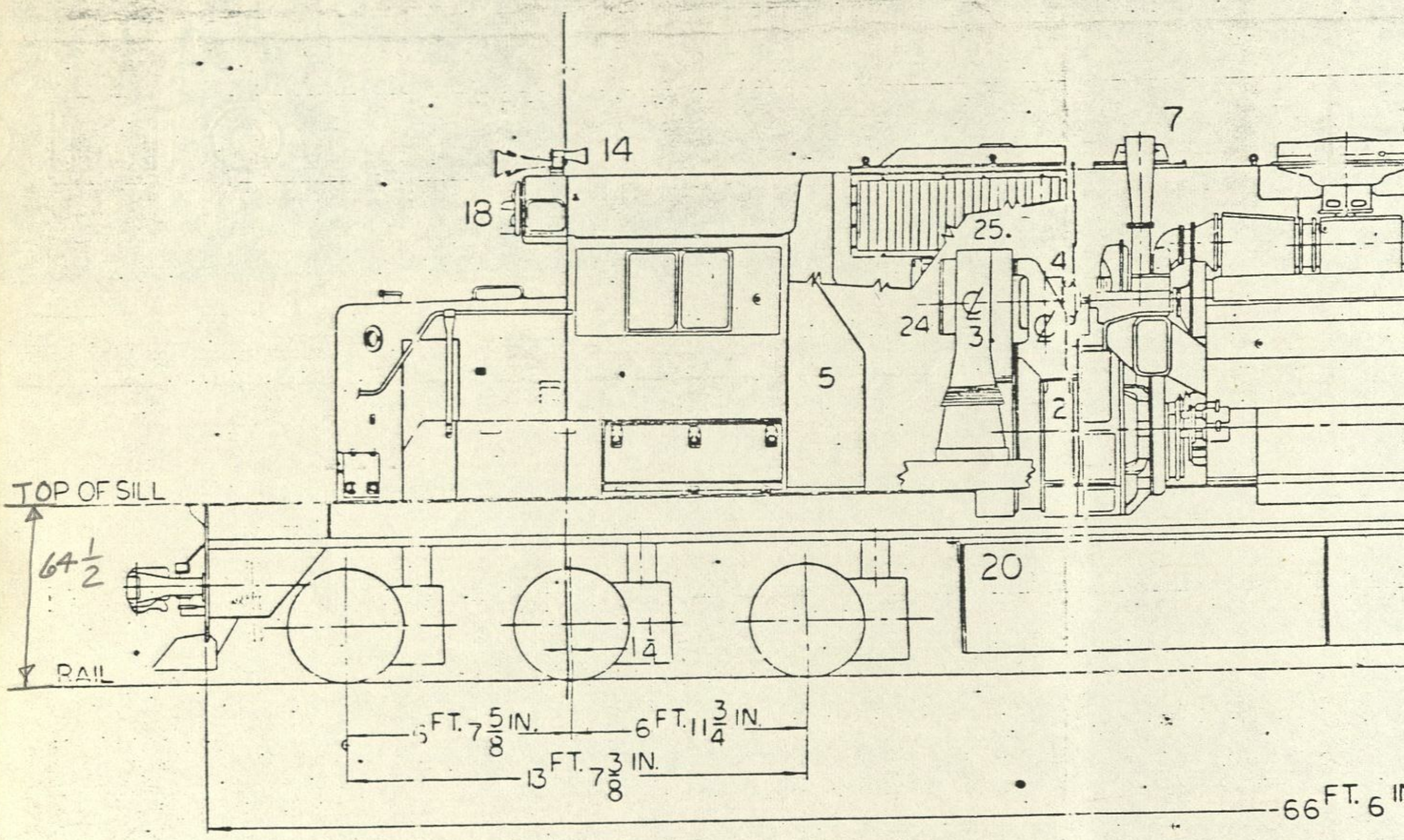

9
38
8
37
19
8 3/4
28
17
20 FT 3
℄ FUEL TANK FILLER
34
33
13 FT 1 3/8 IN.
25
10 FT 7 IN.
45 FT 5
70 FT 8
℄ CAB BOLSTER

SD-40T-2

SD40T-2

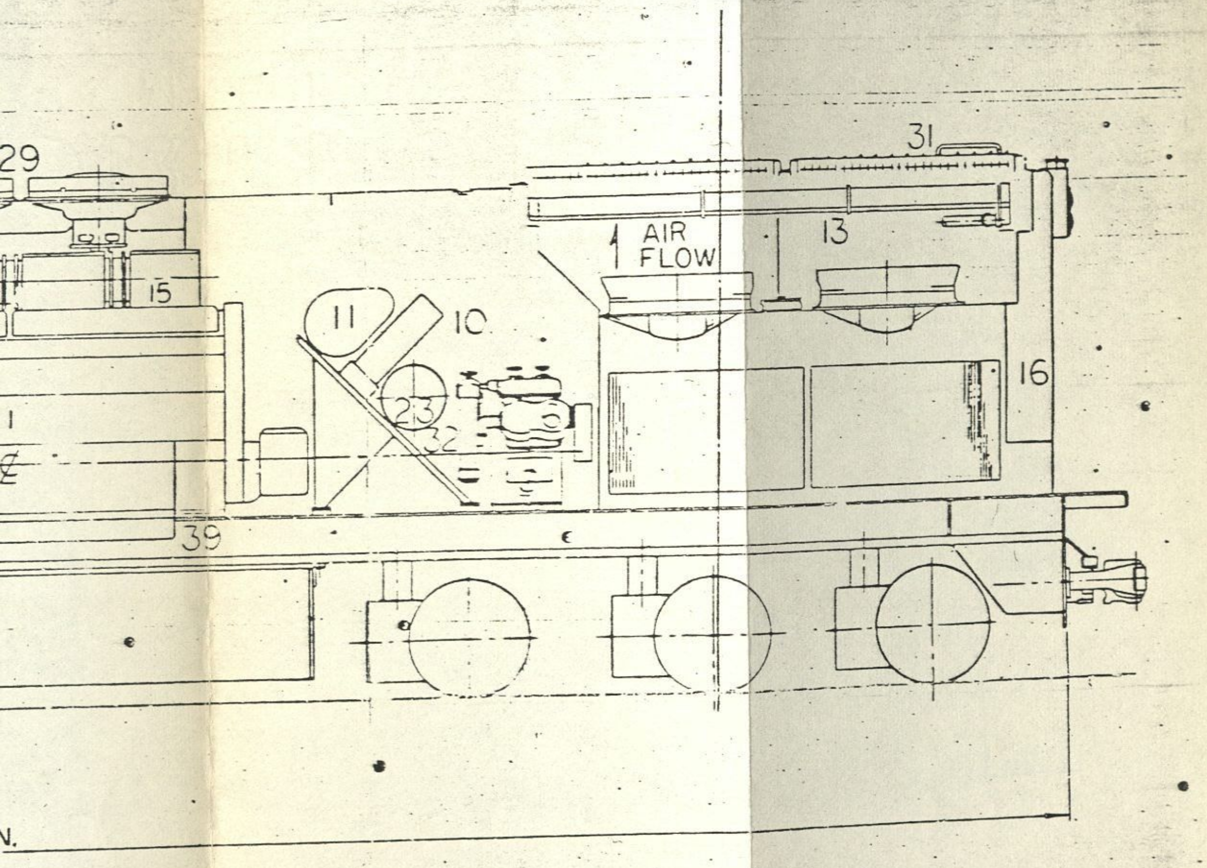

35
9
18
36
15F
22
27
40
8 3/4
21
17
34
IN
10 FT. 6 IN.
25
IN.
IN.
℄ HOOD BOLSTER

SD40T-2


14
18
7
25.
4
24
℄
3
℄
5
2
TOP OF SILL
64 1/2
RAIL
20
1 1/4
6 FT. 7 5/8 IN.
6 FT. 11 3/4 IN.
13 FT. 7 3/8 IN.
66 FT. 6 IN

SD-40T-2

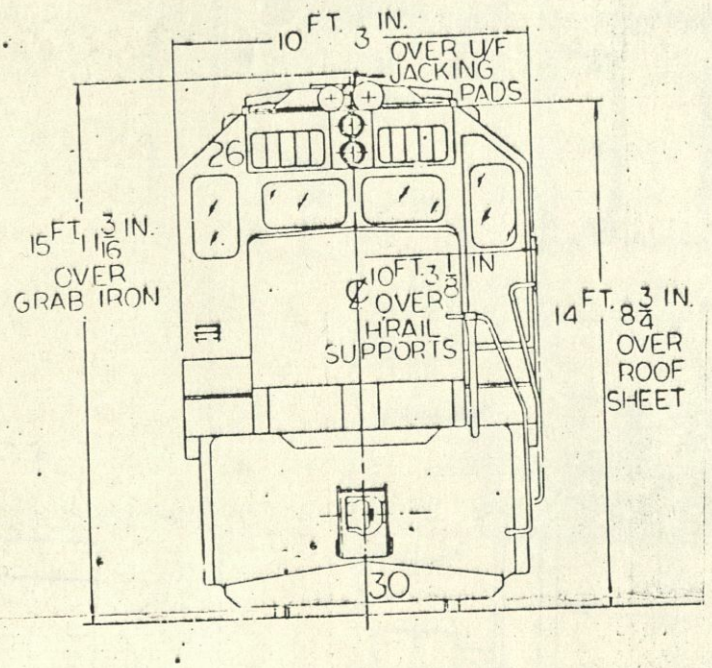
SD-40T-2


29
31
AIR FLOW
13
15
11
10
16
1
23
32
39
N.

NO. REQ

60600	A	HOOD JOINTS, COOLING SYSTEM AND HAND-RAILS MODIFIED	12/5/73	RAC		
RFC NO	REV LET	REVISION	DATE	BY	CK	APPD

SD-40T-2

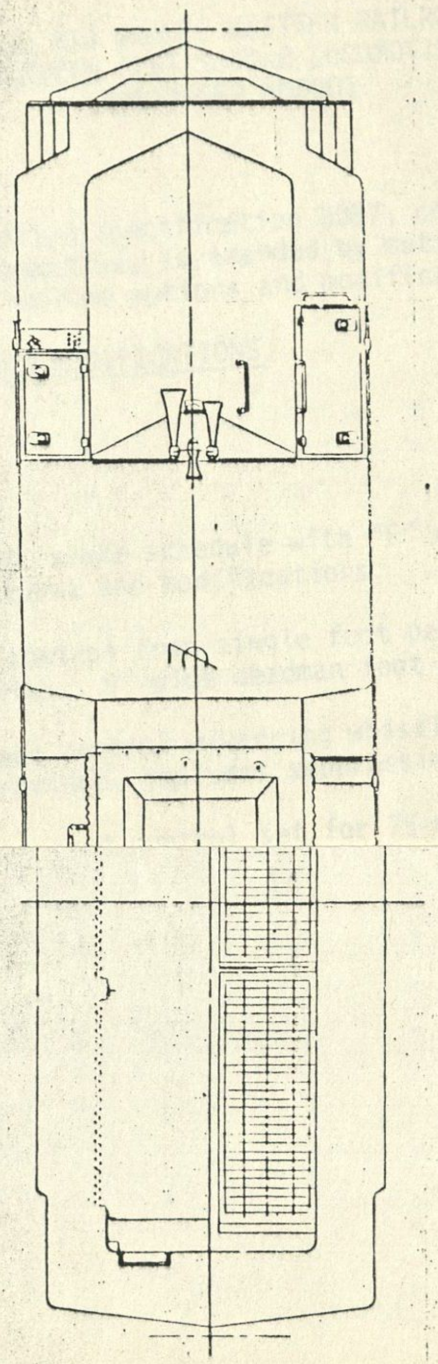


10 FT. 3 IN. OVER U/F JACKING PADS
15 FT. 11 3/16 IN. OVER GRAB IRON
℄ 10 FT. 3 1/8 IN OVER H'RAIL SUPPORTS
14 FT. 8 3/4 IN. OVER ROOF SHEET
26
30

1981

ELECTRO-MOTIVE
Division of General Motors Corporation
La Grange, Illinois 60525

January 16, 1980

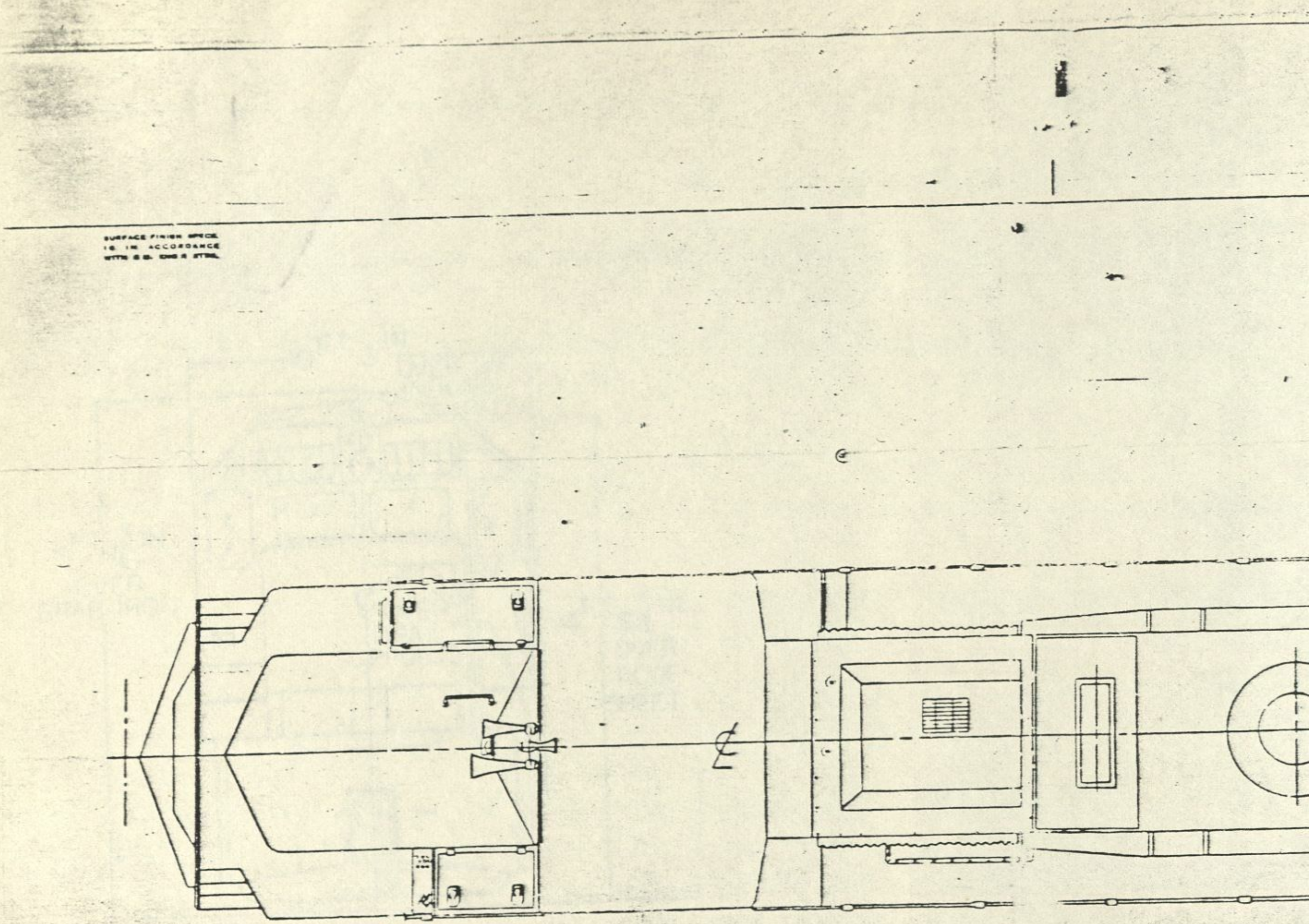


SD40T2

b. Aeroquip MU hoses at both ends

c. Smith - vented ball-type cutout cocks.

SD-40T-2

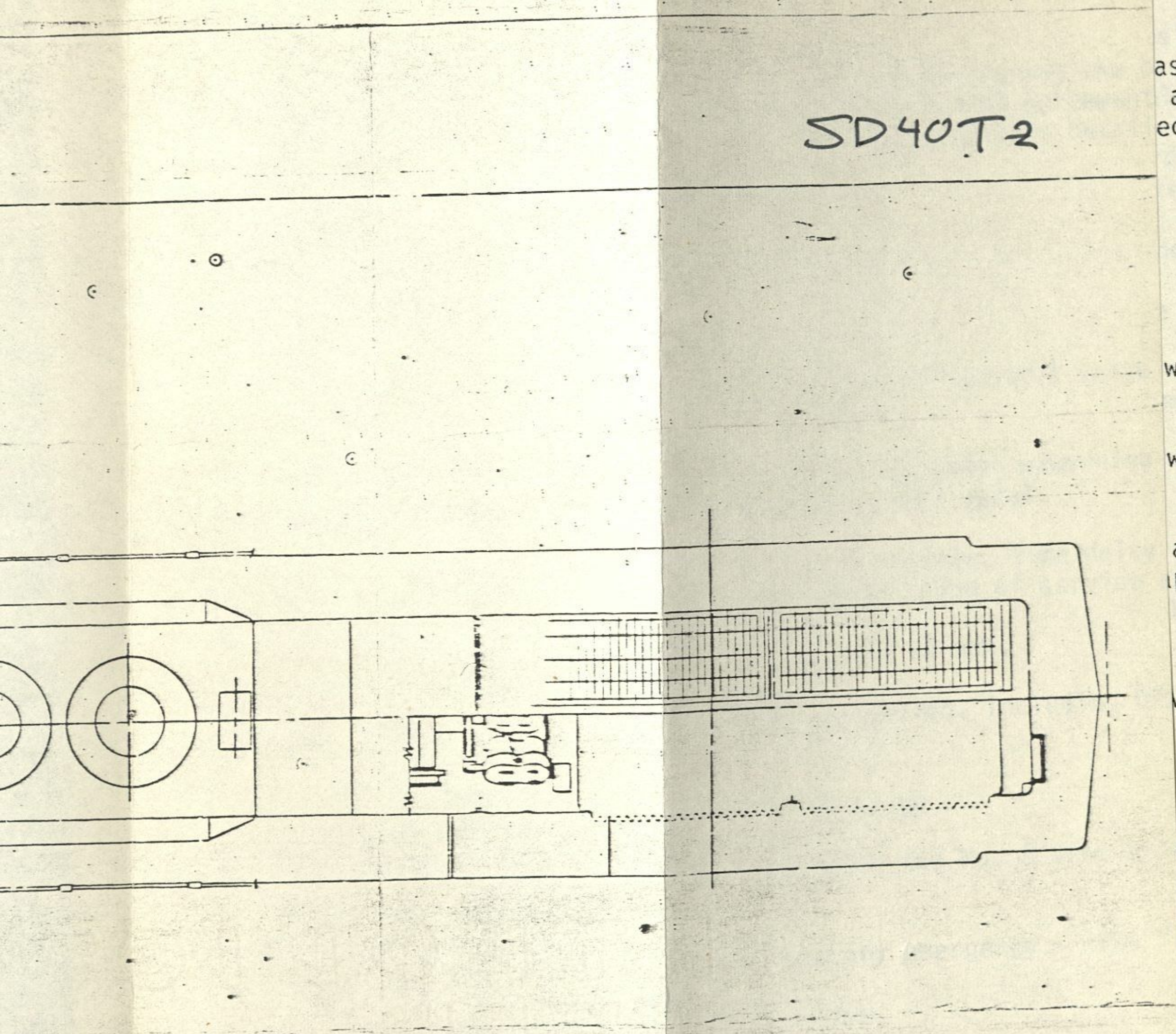

SURFACE FINISH SPECS.
IS IN ACCORDANCE
WITH G.E. ENG'G STDS.
℄

1981

ELECTRO-MOTIVE
Division of General Motors Corporation
La Grange, Illinois 60525

January 16, 1980

AGENDA


SD40T2

asic 3,000
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w/the follow-

whistle and

and PC knock-
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valve and

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ned.

f coupler only.

1981

ELECTRO-MOTIVE
Division of General Motors Corporation
La Grange, Illinois 60525

January 16, 1980

AGENDA

DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY
SIXTEEN (16) SD40-2 LOCOMOTIVES
EMD ORDER 806001

I. GENERAL

General Motors Locomotive Specification 8087, covering the basic 3,000 Horsepower SD40-2 locomotive, is amended by mutual agreement and settlement of details, to include options and modifications detailed below.

II. LOCOMOTIVE OPTIONS AND MODIFICATIONS

A. AIR SYSTEM

1. Air Brakes

   a. Basic 26L brake schedule with "F" control valve w/the following features and modifications:

   b. Safety control from single foot pedal w/warning whistle and time delay. 9" wide deadman foot pedal.

   c. Overspeed control w/warning whistle, time delay and PC knockdown provided, includes suppression of service application.

      1. Overspeed control set for 75 mph.

   d. Provision for service application, including P2A valve and PC switch.

   e. A-1 Charging Cutoff Pilot Valve

      A-1 Charging valve including two No. 8 vent valves, controls the following functions:

      a. Power knockdown from any emergency - trainlined.

      b. Brake pipe break-in-two.

   f. Air End Connections

      a. Basic duplex air end connections.

      b. Aeroquip MU hoses at both ends on one side of coupler only.

      c. Smith - vented ball-type cutout cocks.

A. AIR SYSTEM

1. Air Brakes - Cont'd.

g. Other Air Brake Modifications

1. Independent brake valve pressure set for 90 psi on the gauge.
2. Removable offset independent brake valve handle.
3. Removable automatic brake valve handle.
4. Conductor's brake valve in cab provided basically.
5. J1.8-18 proportioning valve (180% relay valve) is provided.
6. Apply street L with proper choke on forward side of exhaust port exhausting downward on automatic brake valve.
7. Independent valve to have threaded hole and 2" pipe nipple to exhaust inside control stand.
8. 1/2" "DL" line filters are provided in the actuating and independent MU lines.
9. Provision for compatible operation w/locomotive equipped with 6BL brakes not provided.

2. Air Compressor

a. Basic three-cylinder water-cooled compressor.

b. Air compressor synchronization provided w/dual-contact pressure switch.

c. Filter is Air Maze.

d. Gauge must be magnetic coupling type.

3. Gauges and Fittings

a. Salem 4-1/2" air gauges - green dial.

b. Salem test fittings.

c. Salem test fitting in line to compressor gauge & unloaded switch.

4. Main Reservoirs

a. Filters

Basic Salem 818 and 824 centrifugal filters, located after the No. 1 and No. 2 main reservoirs, filter air for the auxiliaries and the air brake, respectively.

A. AIR SYSTEM

4. Main Reservoirs - Cont'd.

b. Drain Valves

Salem 880 automatic drain valves on both main reservoirs.

c. Actuation of Filters and Drain Valves

Blowdown of filters and automatic drain valves is actuated by Salem 872 timer - One (1) minute intervals.

5. Warning Devices

a. Bell

Basic application

b. Horn

Basic Leslie SL-3L-R horn, mounted at basic location on centerline of the cab roof w/two bells facing forward and one rearward. (8" total height including mounting).

B. SANDING

1. Control

a. Basic inboard - outboard sanding.

b. Basic electric control only. Assignment of trainline control wires covered under C.2.b. below.

c. Modular system of wheel slip control provided basically.

d. Automatic sanding from any emergency brake application.

2. Switches & Lights

1. Manual (directional) sanding switch is basic nonlatching type.

2. Lead axle sanding switch is basic latching type.

3. Indicating light shows all sanding conditions, except wheel slip sanding.

3. Sanding Traps and Related Devices

a. A total of eight (8) basic 273 sand traps, including integral rotary shutoff valve, are provided.

4. Sand Box

a. Capacity

Increased sand box capacity of 36 cubic feet per end.

B. SANDING - Cont'd.

5. Automatic 60-second timed sanding from any emergency.

6. Other Sanding Modifications

   a. Sanding air supply taken from No. 2 main reservoir instead of No. 1.

   b. Sanding directional control and emergency per AAR standards.

C. MULTIPLE UNIT CONTROL

Multiple Unit Control is provided. The following modifications/features are provided.

1. Cables

   a. One (1) 27-point EMD jumper cable, nine feet long.

2. Receptacles

   a. Single twenty-seven point Pyle-National WWRF27K receptacle at each end.

   b. Pin assignments per AAR standards.

   c. Receptacle is located in end plate, both ends.

3. Walkway Ramps

   a. Folding walkway ramp is provided at front end of locomotive.

   b. MU safety chains are mounted on separate support posts, both ends of locomotive with hangers.

D. DYNAMIC BRAKES

1. Extended range dynamic brakes w/the following features and modifications:

   a. Standard potential control trainlined on #24 wire.

   b. Standard EMD System in which braking effort is regulated by motor field excitation current -- i.e., with any given position of control handle (throttle), braking effort increases as speed increases up to the 700-amp maximum.

2. Interlock

PC switch used for Type II, non-reapplying interlock. i.e., the locomotive brake will not reapply after release of a dynamic brake application which had earlier caused release of an automatic service application. The independent air brake function is not affected by dynamic brake interlock.

D. DYNAMIC BRAKES - Cont'd.

3. Load Test Provision

Provision is made for load testing locomotive on its own dynamic brake grids.

4. Grid Protection Circuit

Special circuit is provided to nullify dynamic brakes in response to grid blower motor failure.

5. Other Dynamic Brake Modifications

a. DBI solenoid located on brake valve side of dual-ported cutout cock.

b. D&RGW special dynamic brake cutout switch circuitry.

c. Air system is modified to provide individual unit bleed-off of dynamic brake interlock per D&RGW drawing, dated December 14, 1972.

E. ELECTRICAL CONTROL MODIFICATIONS

Motors are connected in series-parallel for starting and make transition to full parallel. No motor shunting is provided.

1. Batteries

a. Exide UD-466 unitized.

b. 100-amp battery charging receptacle provided in electrical cabinet.

2. Auxiliary Generator

18 KW AC auxiliary generator in place of basic 10KW DC.

3. Traction Motor Lockouts

Not provided.

4. Ground Relay Reset

a. Barco automatic ground relay reset is provided with reset for the automatic device in the electrical cabinet.

b. Basic manual reset button is retained on control stand.

c. Ground relay reset is trainlined to AAR standard.

E. ELECTRICAL CONTROL MODIFICATIONS - Cont'd.

5. Other Control Modifications

a. Manual power reduction, trainlined per AAR standards; three-position switch - off, MU, Single -- add blocking rectifiers per customer's sketch.

b. Faraday alarm buzzer located bottom right-side of control stand (outside of control stand).

c. Modification to permit operation of manual transition units in consist not required.

F. ENGINE MODIFICATIONS

1. Filters

a. Primary (carbody) Filters

1) Basic inertial separator, providing filtered air to engine filter and generator-motor blower. Customer specifically requires AAF elements.

2) Inertial Blower Motor Protection

Basic circuit breaker prevents motor overload. Indicating light on engine control cabinet indicates tripped circuit breaker, resulting from motor overload condition.

b. Engine Air Filters

AAF "bag-type" engine air filters.

2. Oil Pan

Oversize oil pan increases lube oil capacity to 396 gallons.

3. Engine Turning Jack

None required.

4. Fuel Oil Preheater

a. Young fuel oil pre-heater is required - Part No. 9517269 - with Amot thermostatic by-pass valve -- rack mounted.

b. Pre-heater is piped into pressure side of fuel pump.

5. Bolted-on engine crankshaft stubshaft assembly provided.

F. ENGINE MODIFICATIONS - Cont'd.

6. Other Engine Modifications

a. Exhaust manifold inspection part is provided.

b. Engine purge control provided.

c. Low engine idle speed is basic.

d. No spark arresting manifold is required in conjunction with turbocharged engine exhaust emissions.

e. Low water - high crankcase pressure engine shutdown device provided basically with 20 psi pressure cap.

f. Turbocharger screen assembly includes, basically, a trap box attached to the outer body at the bottom which collects small debris.

G. TRUCKS

1. Basic single shoe truck design with the following features and modifications:

a. Gear Ratio

62:15 gear ratio provides full horsepower to 65 mph and a minimum continuous speed of 11.1 mph.

b. Axles

1. Axles with 6-7/8" journal diameter provided basically.

2. Axles splined at both ends.

c. Wheels

1. Forty-inch D-40 wrought steel wheels w/AAR contour machined witness groove is basic. Class BR wheels.

2. Journal Boxes

a. Hyatt JEM journal boxes, new only, supplied basically.

b. Oil Fill Cups

Plugs replace basic JEM quick-fill oil cups.

c. Grind relief on all corners of journal box guides.

G. TRUCKS - Cont'd.

3. Slack Adjusters

EMD pin type.

4. Huck Fasteners

Not used in truck construction.

5. Traction Motor Modifications

a. Traction motor bottom inspection covers are hinged at one end and bolted at the opposite end.

b. Traction motor support bearings ~~with~~ Seal rings. (new bearings)

H. CAB MODIFICATIONS

1. Cab Seats

a. One Coach and Car (1291702-D) slide-rail-mounted cab seat with backrest and armrests is provided at engineer's position.

b. Two Coach and Car slide-rail-mounted cab seats are mounted on the observer's side and include the following:

1) Padded armrests.

2) Special seat cushion material.

3) Special seat cushion contour (front radius is greater than rear radius).

4) Dark green color.

c. The three cab seats are equipped with D&RGW monograms.

2. Water Cooler

Ajax #685 water cooler (includes two-gallon basic bottle and Dixie Model 1444-S cup dispenser).

3. Speed Indicator/Recorder —may Change to LCP

Chicago - Pneumatic grease - lubricated speed recorder is to be provided with 0-90 mph - black face dial with barrel type keys -- includes overspeed switch. Recorder cable to be on right side -- drive off right #3 axle journal.

H. CAB MODIFICATIONS - Cont'd.

4. Temperature Control

   a. Electric cab heaters replace basic hot water units. Application requires that basic 10KW auxiliary generator be replaced with one of 18KW capacity.

   b. The switch controlling the right side strip heater is a round knob so that engineer can distinguish strip heater switch from the headlight switch at night.

5. Cab Flooring

   Rough surface 3/8" thick Benelex covering the plywood base.

6. Awnings

   Prime folding metal awning Model SC977-31 on both sides of cab.

7. Wind Deflectors

   Salem 651-M-1 full length mirror wind deflectors front only on both sides.

8. Doors, Windows, Glass

   a. Lexgard rail laminate ~~Lexan polycarbonate glazing, Model MR40T4-111~~, replaces basic glass in sliding cab windows, both sides.

   b. Elcon National Triplex "Y" glazing replaces basic glass in all front and rear cab windows.

9. Controller

   a. Basic single control station.

   b. Controller

      Basic AAR-approved "three-handle" arrangement, with separate controls for power and dynamic brake control.

10. Other Cab Modifications

    a. Basic zero-center ammeter indicates motor amps under power w/clockwise deflections from the "zero-center" position and braking current with counter-clockwise deflections.

11. Phase II AAR/EMD Clean Cab is provided basically.

    a. Padded sunvisor required on Fireman's side of cab as well as basic on Engineer's side.

I. RADIO

Radio or provision for radio is provided by the customer.

J. CARBODY

1. Basic Low Profile Short Hood

a. The short hood end of the locomotive is considered the front.

b. A en stneciled "F" is located on the side sill near the end of each side to identify that end as the front.

2. No. 1 (front) end arrangement

a. EMD large snowplow pilot Part No. 8475665 less doors.

b. Sidesteps

Basic ~~14-inch~~ 15 inch clearance.

3. No. 2 (rear) end arrangement

a. Hose storage rack not required - flat plate only - no slots --bottom of plate 6" above rail.

b. Sidesteps

Basic ~~14-inch~~ 15" clearance.

4. Coupler/Draft Gear

Basic ~~NC391~~ HTE 8311 draft gear and ~~"E"~~ HTE coupler with alignment control at both ends.

5. Lights

a. The basic complement of lights, specifically including twin-sealed beam headlights at both ends.

b. Translite Model 20585 DWFV twin-sealed beam white signal light, including inching feature, provided in low short hood. Slow oscillation is provided.

6. Fire Extinguishers

Basic complement, consisting of the two 20-pound Ansul dry powder extinguishers, one in the cab, the other in the engine compartment.

7. Toilet

a. Microphor Model LF310 stainless steel toilet w/integral sequence and H8 digestive system, including chlorinator, water tank and immersion heater. The following EMD Part numbers apply:

Treatment System, including chlorinator - 8484976, 8484977, 8484978, 8484979, 8484980, 8484981, 8484892.

J. CARBODY

7. Toilet - Cont'd.

b. Heating with control for under toilet bowl -- See customer's sketch for details.

8. Lifting and Jacking Devices

a. Jacking Pad/Cable Sling

Basic arrangement only, consisting of one combination sling/jacking pad welded to the underframe side sill, near the longitudinal bolster center.

b. Supplemental Lifting Eyes

Lifting eyes in end sheet are provided, both ends.

9. Locomotive Weight

a. Nominal loaded weight, including all modifications and supplies is 390,000 pounds. The standard manufacturing tolerance may result in a plus or minus 5,000 pound variation from the nominal weight. Variation between trucks does not exceed 5,000 pounds.

b. Locomotive scale weight record, EMD Form 420D, to be furnished for each locomotive.

10. Clearance

a. Height

No special height restrictions.

11. Other Carbody Modifications

a. Low level cooling air intake (tunnel modification) with 20 psi pressure cap (stronger clips on cooling fan guards).

b. Handrails follow contour of platform on No. 2 (rear) end and are positioned 2-3/8" inboard of the platform edge.

c. Offset provided inside underframe-mounted handrail adjacent to rear ladder steps, both sides of locomotive.

d. Curved horizontal grab iron provided at rear of long hood, engineer's side only. Grab iron extends from side of long hood around to rear and is at same height as underframe-mounted handrails.

e. Slot provided in side of long hood at No. 2 end (rear) ladder steps, both sides of locomotive.

NOTE: Slots permit light from the basic rear end platform lights to illuminate the ladder steps.

J. CARBODY

11. Other Carbody Modifications - Cont'd.

f. Type "F" glad-hand connections replace the basic "rattlesnake" connections for water fill at the following two locations:

1) Cooling system water fill.

2) Toilet water fill, both sides of locomotive.

g. Basic steplights in place of ground lights.

K. FUEL TANK

1. Capacity

Optional fuel tank provides 4,000 - gallon capacity.

2. Filler Pipes

One additional fuel filler pipe on each side, i.e., total of four.

3. Gauges

a. Qualitrol dial-type gauges, both sides--to be mounted at a 35° angle like the Southern Pacific.

b. One (1) eight-inch fill gauge adjacent to each basic filler pipe, i.e., total of two.

4. Automatic Fuel Fill Adapters (Shutoff Device)

Buckeye adapter w/external G-1620-103 adapter to be provided. See customer's sketch for details.

L. STYLING AND PAINTING

In accordance with drawings prepared by EMD and approved by D&RGW.

1. Paint

a. Exterior

1. Drawing 9085195 as approved by the customer on April 9, 1979.

2. Polyurethane Paint

A two-color polyurethane paint scheme calls for application of polyurethane paint to all exterior carbody surfaces. Specifically not receiving the polyurethane paint are the fuel tank, air reservoirs trucks and other undercarriage surfaces which receive basic enamel.

L. STYLING AND PAINTING

1. Paint - Cont'd.

b. Interior

1. Drawing 9085195 as approved by the customer on April 9, 1979.

2. Reflective/Non-Reflective Markings

None Required.

3. Identification

a. The front end of the locomotive is identified as such with a stenciled "F" applied to the side sill on both sides.

b. Number Boxes

Number panels are of fiberglass construction and include white numbers on black background.

c. Road and Serial Numbers

ROAD NUMBERS	SERIAL NUMBERS
5398 through 5413 5414	786264-1 through 786264-16

d. Other Identification Modifications

ACI Labels - Not Required.

M. SHIPMENT

1. Consignment and Routing

In accordance with written instructions furnished by railroad.

2. Operating Supplies

Locomotive is shipped w/full charge of Arco GL Supreme lube oil.

N. DRAWINGS

Standard set of drawings provided.

1. Half size Mylar (to be 4 mil - double matte) of the following:
   - a. Physical schematic wiring diagram.
   - b. Cable and conduit layout.
   - c. Wire running list.
   - d. Setting chart.
   - e. Schematic air piping.

DENVER & RIO GRANDE
EMD ORDER A-786264

N. DRAWINGS - Cont'd.

2. Full size sepia of remainder.

NOTE: The physical schematic wiring diagram, the cable and conduit layout and the location diagrams of the wire running list are on one drawing. (See sample dwg. from customer)

J.E. Schnabel

J.E. Schnabel
Sales Engineering

JES:plm/vad

EMD LOCOMOTIVES

Speed - Tractive Effort Curves
&
Dynamic and Extended Range
Dynamic Braking Curves

For

	TE	DB	ER
SD-45'S	✓	✓	✓
SD-40'S	✓	✓	✓
GP-40'S	✓	✓	✓
GP-35'S		✓	
GP-30'S	✓	✓	

Note 2 sq = 1 mph
2 sq = 1000# breaking effort

J E Timberlake D&RGW
Director - Unit Train Operation

11/16/71

SD-45'S Unit Train Service

Spec's & reasons for SD-45's on unit trains

62:15 gear ratio - 70 mph -	
Radiator sprays -	cooling in tunnels at high altitude particularly where many tunnels closely spaced (Moffat
Power limiting -	Occurs at about 17½ mph on SD-45 vs 24 mph on GP-40. ∴ Full hp 3600 down to 17½ mph vs 3000 which starts to limit at 24 mph.
Extended Range Dynamic -	Peak brake 60M#s at 24½ mph, but still get 59½ M#s at 8½ mph on SD-45, (same on SD-40), vs 40M# peak at 24½ mph vs 39½ at 8½ mph on GP-40 with extended range. ∴ More braking over all ranges with SD-45 whether with or without extended range. [EG, an SD-45 with standard gives 40M (same as GP-40 peak) at 16½ mph while GP 40 puts out 40M at 24½ MPH. GP-40 std at 16½ puts out only 26½ M] Note: Function of # traction motors 6 vs 4 more than anything else
Trainlined Power Reduction. -	Permits fine tuning throttle of one or ~~more~~ all units thus enabling very slow speed opn and enabling operation at max amps just below wheel slip limit. Useful both in load-in-motion control and over the road on ascending grades to keep from slipping down.
Turbocharged -	Account altitude - all power

27 point jumper - We use 22 on SD-45's with trainlined pwr reduction.

SD-45

SD-45

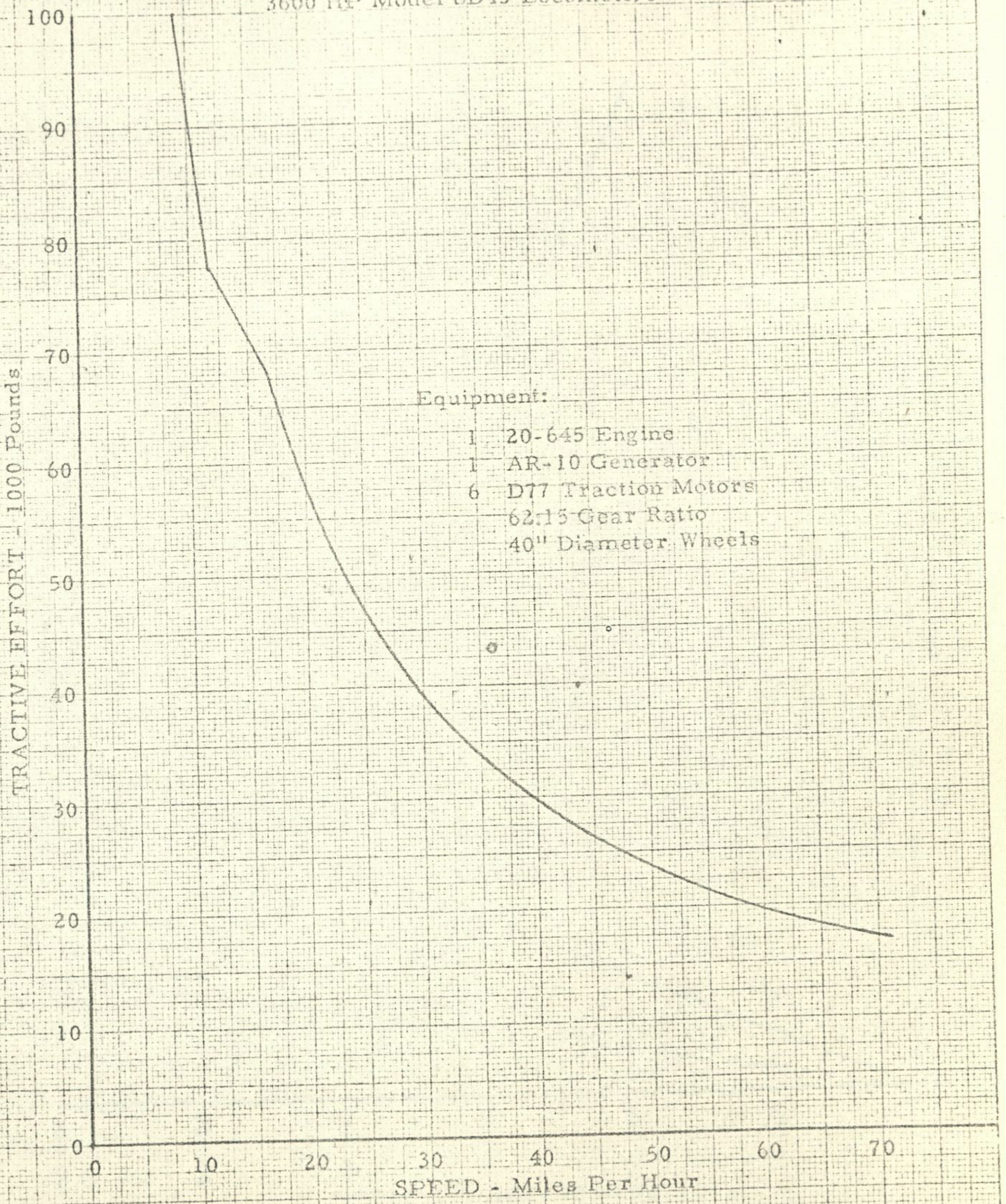
T.E Curve
Braking Curve

SD-45
Speed-TE Curve

6-9-65

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3600 HP Model SD45 Locomotive



Equipment:
1 20-645 Engine
1 AR-10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

SC-2617

Product Application

359-10 KEUFFEL & ESSER CO.
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

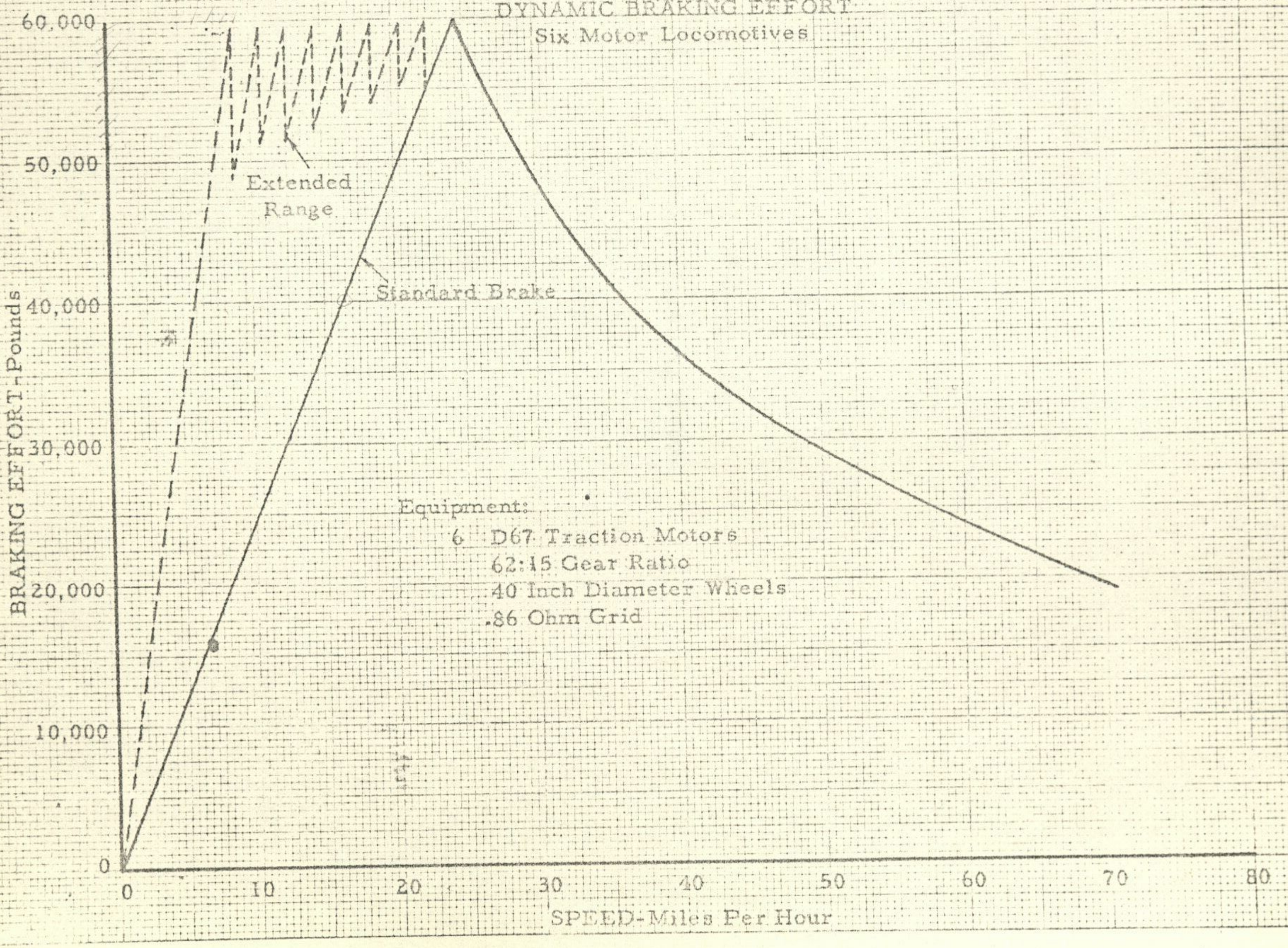
EUGENE DIETZGEN CO.
MADE IN U. S. A.

SD-45
Dynamic & Extended Range Dynamic Braking Curves

11 [illegible] 64
Rev. B

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

DYNAMIC BRAKING EFFORT
Six Motor Locomotives



Equipment:
6 D67 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

SC-2570

SD-40

SD-40

TE Curve

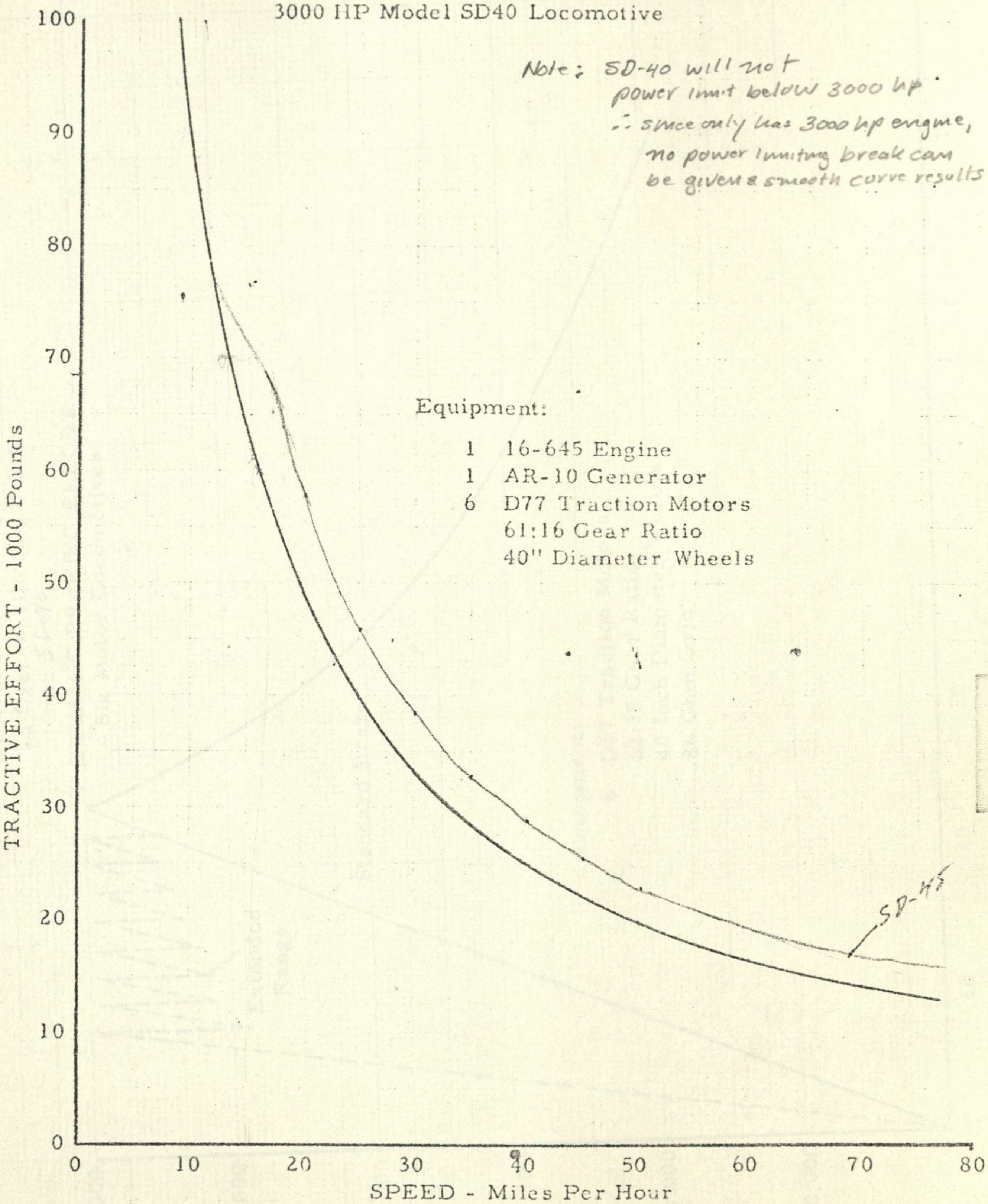
Braking Curve

SD-40
Speed-TE Curve
with
SD-45 curve
roughed in

6-9-65

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3000 HP Model SD40 Locomotive



Note: SD-40 will not
power limit below 3000 hp.
∴ since only has 3000 hp engine,
no power limiting break can
be given a smooth curve results

Equipment:

1 16-645 Engine
1 AR-10 Generator
6 D77 Traction Motors
61:16 Gear Ratio
40" Diameter Wheels

Product Application

SC-2616

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U.S.A.

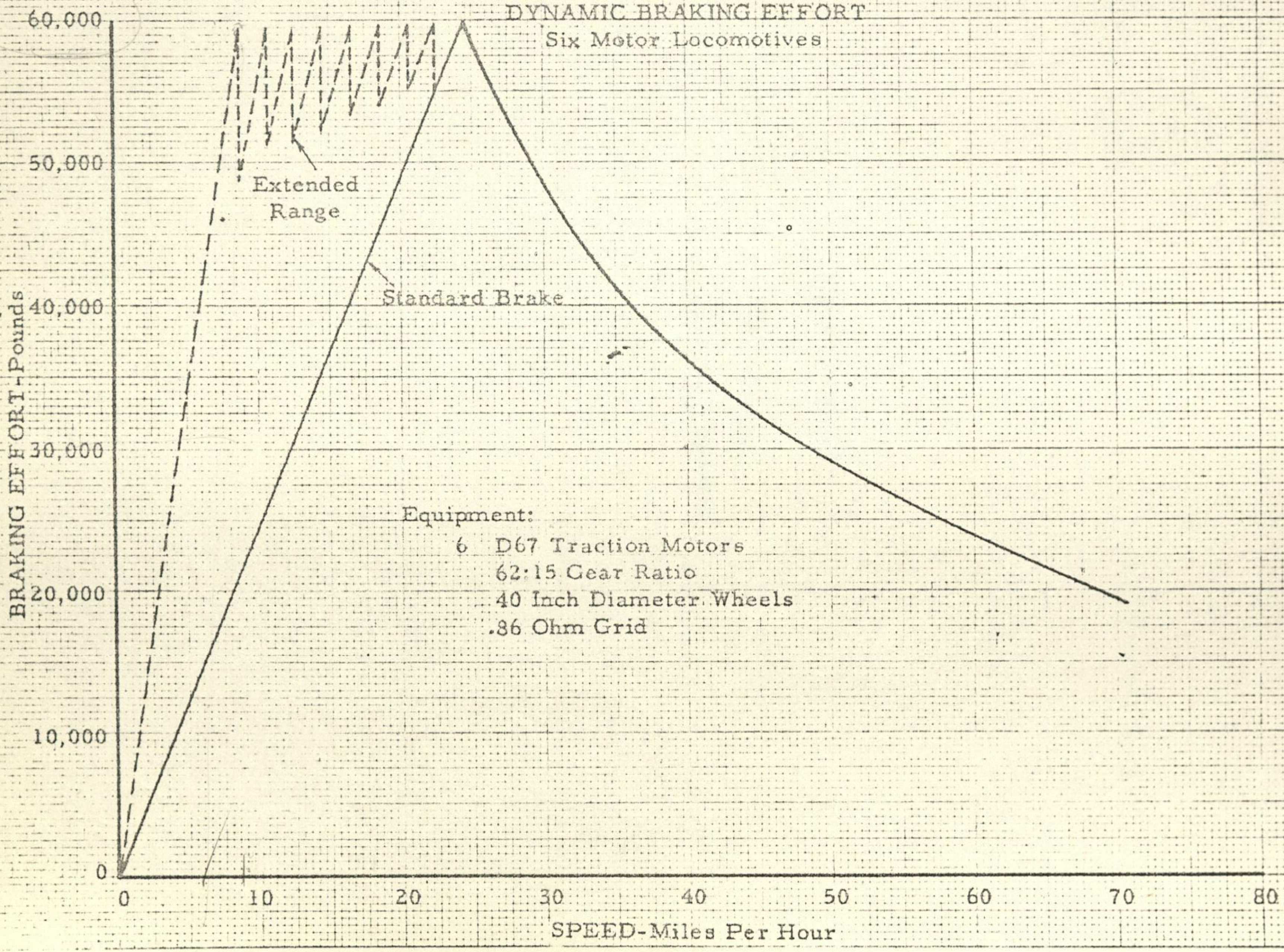
SD-40
Dynamic & Extended Range Dynamic Braking Curves

11-4-64
Rev. B

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.
SD-40

DYNAMIC BRAKING EFFORT

Six Motor Locomotives



Equipment:
6 D67 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

-2570

GP-40

GP-40

T.E Curve

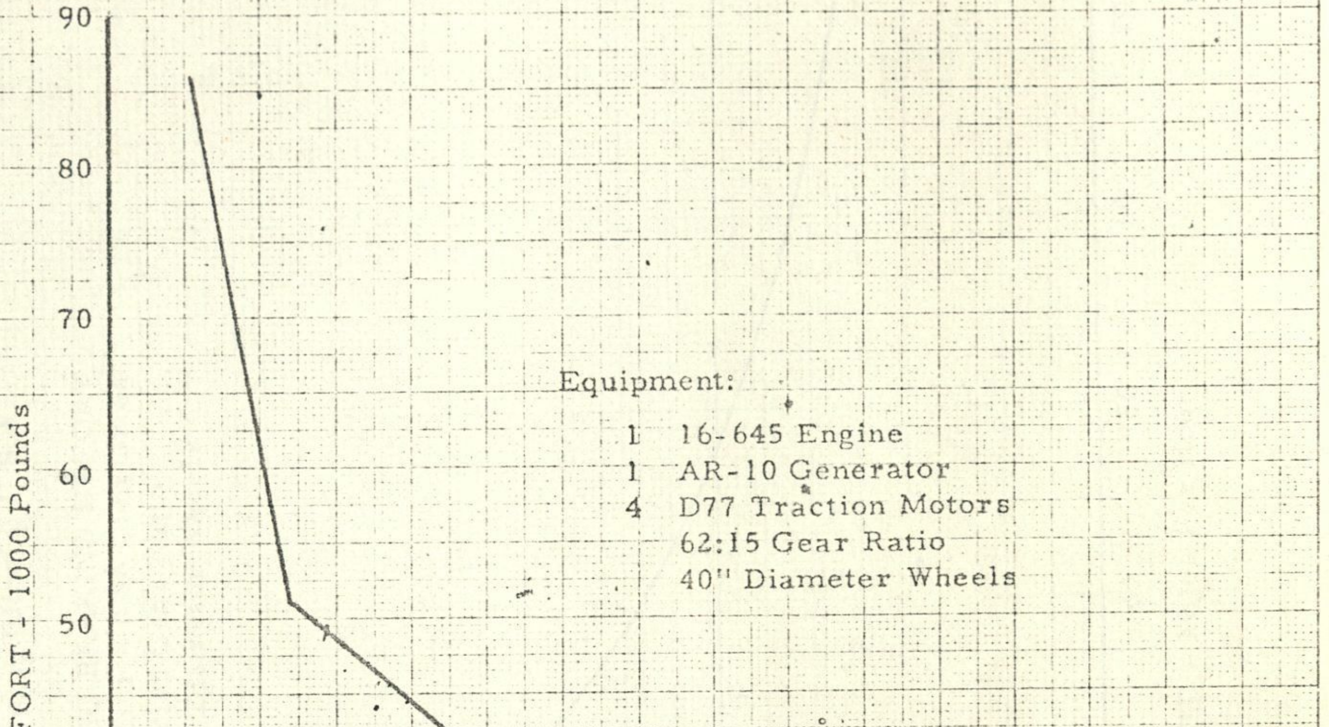
Braking Curve

GP-40
Speed - TE Curve

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

6-9-65

SPEED - TRACTIVE EFFORT
3000 HP Model GP40 Locomotive



Equipment:

1	16-645 Engine
1	AR-10 Generator
4	D77 Traction Motors
	62:15 Gear Ratio
	40" Diameter Wheels

Product Application

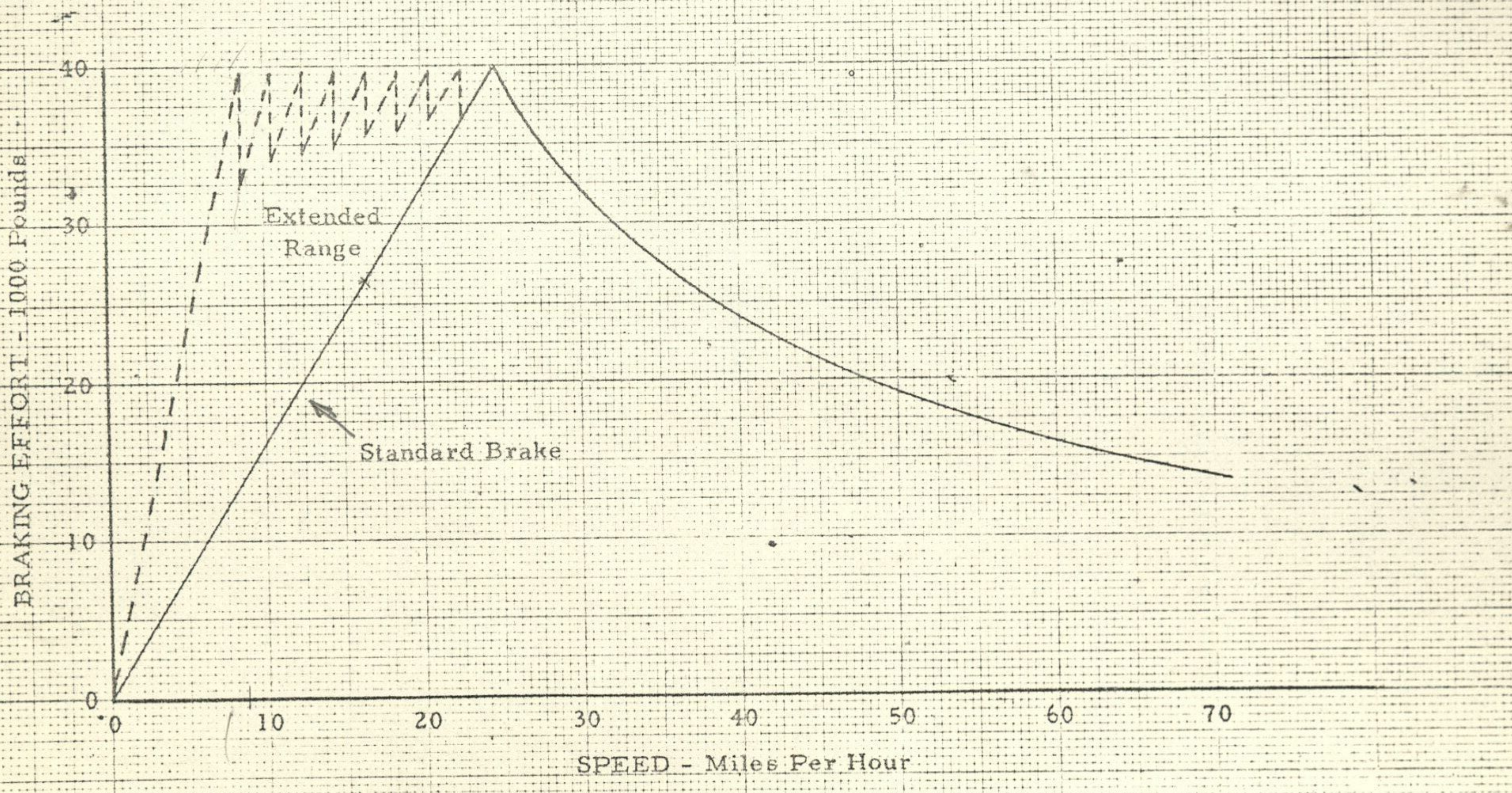
SC-2618

359-14 KEUFFEL & ESSER CO.
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

GP-40
Dynamic Braking GP-40
Extended Range Dynamic Curves
6-9-65
Rev. A

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

DYNAMIC BRAKING EFFORT
Four Motor - 0.86 Ohm Grids
62:15 Gear Ratio
40" Diameter Wheels



Product Application

SC 2563

GP-40
Dynamic & Extended Range Dynamic Braking Curves

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

GP-35

GP-35

Braking Curve

GP-35
Dynamic Braking Curve

FREDERICK POST COMPANY
301TR20 CROSS SECTION 20X20 PER INCH

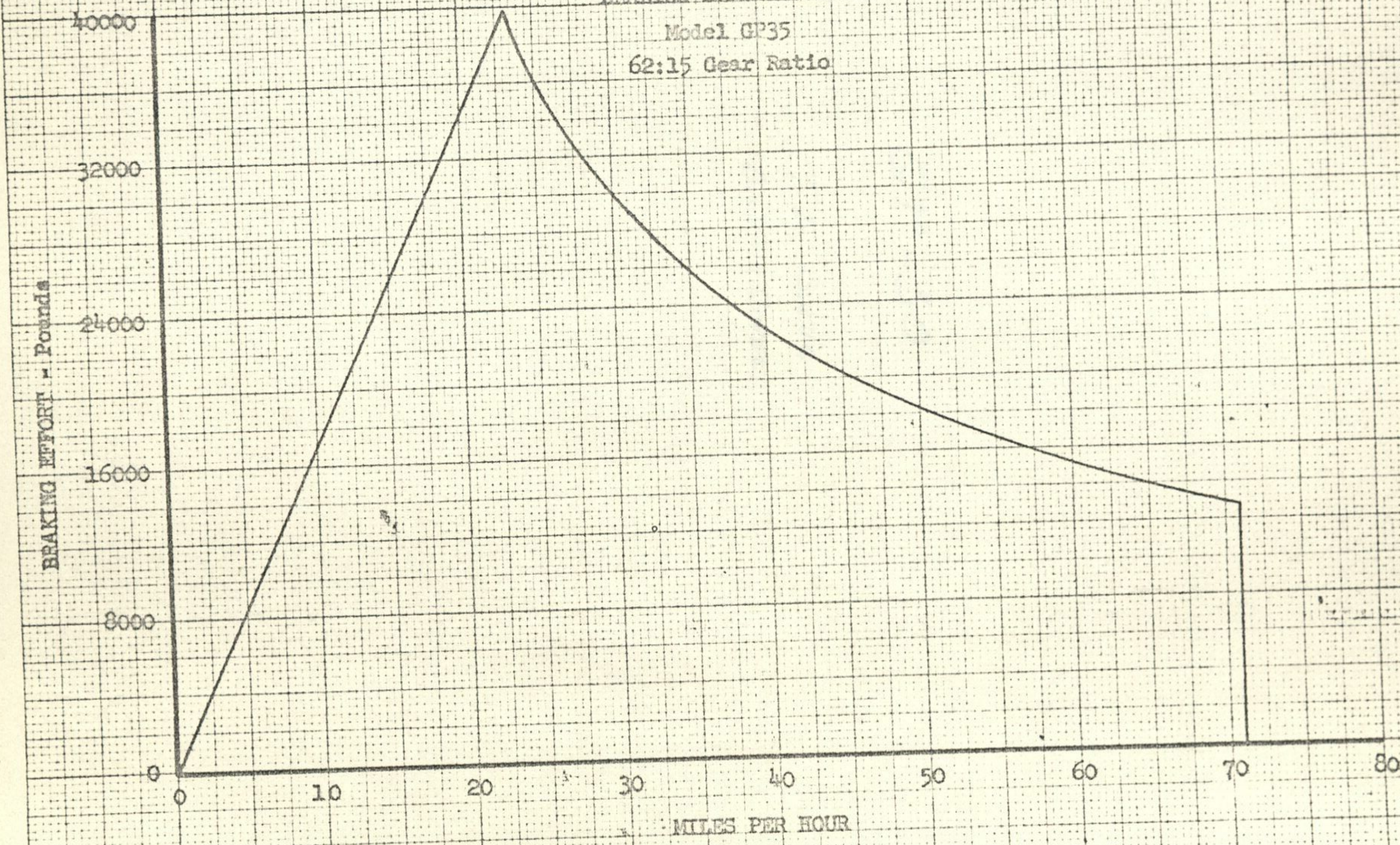
7/30/63

Electro-Motive Division
General Motors Corporation
La Grange, Illinois

BRAKING EFFORT CURVE

Model GP35

62:15 Gear Ratio



SC2562

Product Application

GP-35
Dynamic Braking Curve

GP-30

GP-30

TE curve
Braking Curve

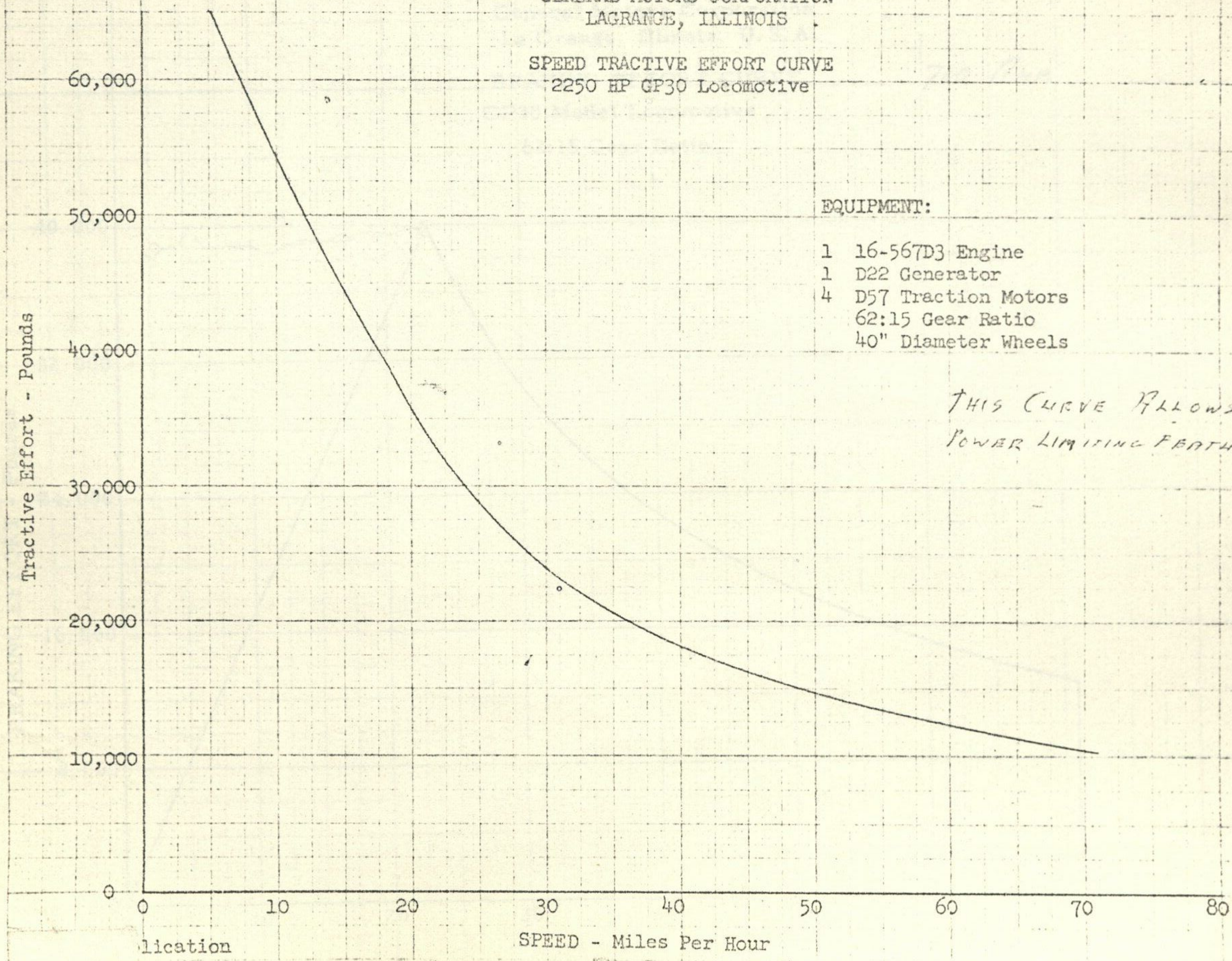
GP-30
Speed - TE Curve

EUGENE DIETZGEN CO. NO. 346 B

10-23-61
Rev. A

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LAGRANGE, ILLINOIS

SPEED TRACTIVE EFFORT CURVE
2250 HP GP30 Locomotive



EQUIPMENT:

1 16-567D3 Engine
1 D22 Generator
4 D57 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

THIS CURVE ALLOWS FOR
POWER LIMITING FEATURE

GP-30
Speed-TE Curve

lication

SC 2395

CP-30
Speed-TE Curve

GP-30
Dynamic - Braking Curve

EUGENE DIETZGEN CO NO 346 G

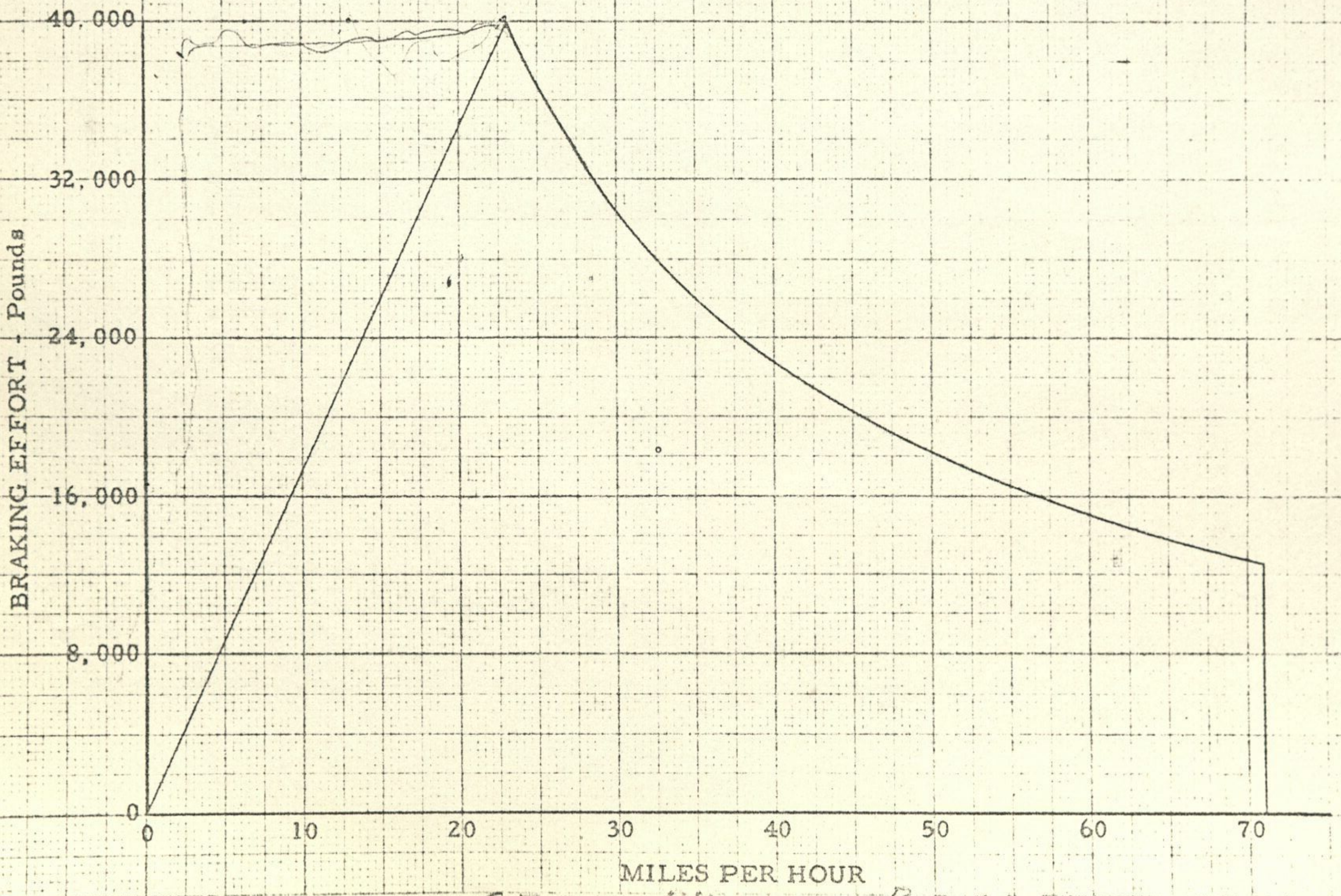
PRINTED IN U.S.A.

10-14-61

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U. S. A.

BRAKING EFFORT CURVE
GP30 Model Locomotive
62:15 Gear Ratio

700 Amp.



SC2503

GP30- DYNAMIC BRAKE

GP-30
Dynamic Braking Curve

OKY

Stover
Celwese

Cobra

COBRA Shoe
is the Red Shoe

JET —

CoP 40-2 Jan-June 1980

Base	567,200
RG Modif	80,000
	647,200

Caboose - 850,000

SD's 275

4/19/79

Railroad Friction Products Corporation, Wilmerding, Pa. 15148
PHONE (412) 271-1490

April 10, 1979

Messrs: H. E. Cash
G. A. Bennewitz, Jr.
R. C. Hagaman
C. H. Smith

Subject: Cost update for SD-40T-2 units

At a joint Rio Grande - EMD meeting held April 5, 1979, we reviewed the specification for our next locomotive order covering delivery of 16 SD-40T-2 early in the second quarter or perhaps late in the first quarter of 1980.

With only 4 items still not finalized and none of these expected to be significant, I estimate that these units will cost $775,000 per locomotive, delivered and fully equipped. I suggest that this number be used in all future cost estimates.

J. E. Timberlake

cc: AHN
DJB
JEC
RGB

4/5/79

Basic $ 662,000
Extras so far 102 300
$ 764 300
+ $10 000? prep-

16 SD 40T-2
delvy early 2nd 1/4 80
~~maybe late 1st 1/4 80~~

ELECTRO-MOTIVE
Division of General Motors Corporation
La Grange, Illinois 60525

March 22, 1979

AGENDA

covering

DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY
SIXTEEN (16) SD40-2 LOCOMOTIVES
EMD ORDER A-786264

I. GENERAL

General Motors Locomotive Specification 8087, covering the basic 3,000 Horsepower SD40-2 Locomotive, is amended by mutual agreement to include options and modifications detailed below.

II. LOCOMOTIVE OPTIONS AND MODIFICATIONS

A. Air System

1. Air Brakes

Basic 26L brake schedule with "F" control valve with the following features and modifications:

a. Provision for service application, including P2A valve and PC switch.

b. Safety control from single foot pedal w/warning whistle and time delay. 9" wide deadman foot pedal.

c. Overspeed control w/warning whistle, time delay and PC knock-down provided, includes suppression of service application.

  1) Overspeed control set for 75 mph.

d. Provision for compatible operation with locomotive equipped with 6BL brakes not provided.

e. Other air brake modifications:

  1) Independent brake valve pressure set for 90 psi on the gauge.

  2) Removable offset independent brake valve handle. Offset is required by AAR/EMD Phase II Clean Cab. Item H.11.

  3) Removable automatic brake valve handle.

  4) Conductor's brake valve in cab provided basically.

  5) J1.8-18 proportioning valve (180% relay valve) is provided.

  6) Apply street L with proper choke on forward side of exhaust port exhausting downward.

A. Air System - Cont'd.

2. Air Compressor

a. Basic three-cylinder water-cooled compressor.

b. Air compressor synchronization provided with dual-contact pressure switch.

c. Filter is Air Maze.

d. Gauge must be magnetic coupling type.

3. Gauges and Fittings

✗ a. Salem 4-1/2" air gauges - green dial

✗ b. Salem test fittings

c. Salem test fitting in line to compressor gauge & unloaded switch.

4. Main Reservoir

a. Filters

Basic Salem 818 and 824 centrifugal filters, located after the No. 1 and No. 2 main reservoirs, filter air for the auxiliaries and the air brake, respectively.

b. Drain Valves

Salem 880 automatic drain valves on both main reservoirs.

c. Actuation of Filters and Drain Valves

Blowdown of filters and automatic drain valves is actuated by Salem 872 timer.

5. Warning Devices

a. Bell

Basic application.

b. Horn

Nathan M3R1 horn, mounted at basic location on centerline of the cab roof with two bells facing forward and one rearward.

✓

B. Sanding

1. Control

a. Inboard & Outboard sanding ~~only~~. ~~Deleted inboard equipment is shipped loose to:~~

~~Material Manager~~
~~Denver & Rio Grande Western Railroad Company~~
~~c/o Mr. G. H. MacDonald~~
~~Burnham Shops~~
~~8th. and Osage~~
~~Denver, Colorado~~

b. Basic electric control only. Assignment of trainline control wires covered under C.3.b. below.

c. Modular system of wheel slip control provided basically.

d. Automatic sanding from any emergency brake application. Refer to Item C.1.a.

e. Switches

1) Manual (directional) sanding switch is basic nonlatching type.

2) Lead axle sanding switch is basic latching type.

3) Indicating light shows all sanding conditions, except wheel slip sanding.

2. Sanding Traps and Related Devices

a. A total of four (4) basic 273 sand traps, including integral rotary shutoff valve, are provided. ~~Deleted inboard sand traps are shipped loose to customer per address noted above, Item B.1.a.~~

3. Sand Box

a. Capacity

* Increased sand box capacity of 36 cubic feet per end.

4. Other Sanding Modifications

* a. Sanding air supply taken from No.2 main reservoir instead of No. 1.

DENVER & RIO GRANDE
EMD ORDER 786264

C. Multiple Unit Control

Multiple unit control is provided basically. The following modifications/features are provided.

1. Provision for Emergency

   * a. A-1 charging valve, including two No. 8 vent valves, controls the following functions:

      1) Power knockdown from any emergency. - check piping so that even if brake cut ~~out~~ out on helper and emergency in train will activate anyhow will knock off pwr — should be basic in piping now

      * 2) Automatic 60-second timed sanding from any emergency.

      3) Brake pipe break-in-two.

2. Cables

   a. One 27-point EMD jumper cable, nine feet long.

3. Receptacles

   a. Single 27-point Pyle-National WWRF27K receptacle at each end. Receptacle is located in end plate, both ends.

   b. Pin assignments per AAR standards.

      1) Sanding directional control and emergency per AAR standards.

      2) Manual power reduction per AAR.

      3) Ground relay reset per AAR standards.
      4) Blocking rectifyers dynamic

4. Provision for Manual Transition

   Modification to permit operation of manual transition units in consist not required.

5. Air End Connections

   a. Basic duplex air end connections.

   b. Aeroquip MU hoses at both ends on one side of coupler only.

   c. Smith-vented ball-type cutout cocks.

C. Multiple Unit Control - Cont'd.

6. Other Multiple Unit Control Modifications/Features

a. 1/2" "DL" line filters are provided in the actuating and independent MU lines.

b. Folding walkway ramp is provided at front end of locomotive.

c. MU safety chains are mounted on separate support posts, both ends of locomotive with hangers.

D. Dynamic Brakes add'l for + 2 speed feature (which sounds like we don't want) } fuel saver feature but have protection problems?

#40,535 (of which 30M is for dynamic only) * Extended range dynamic brakes w/the following features and modifications:

1. Interlock

PC switch used for Type II, non-reapplying interlock, i.e. the locomotive brake will not reapply after release of a dynamic brake application which had earlier caused release of an automatic service application. The independent air brake function is not affected by dynamic brake interlock.

2. Control

a. Standard potential control trainlined on #24 wire.

b. Standard EMD System in which braking effort is regulated by motor field excitation current -- i.e., with any given position of control handle (throttle), braking effort increases as speed increases up to the 700-amp maximum.

* 3. Load Test Provision

Provision is made for load testing locomotive on its own dynamic brake grids.

* 4. Grid Protection Circuit

Special circuit is provided to nullify dynamic brake in response to grid blower motor failure.

5. Other Dynamic Brake Modifications

a. DBI solenoid located on brake valve side of dual-ported cutout cock.

b. D&RGW special dynamic brake cutout switch circuitry.

c. Air system is modified to provide individual unit bleed-off of dynamic brake interlock per D&RGW drawing, dated December 14, 1972.

E. Electrical Control Modifications

1. Transmission

Motors are connected in series-parallel for starting and make transition to full parallel. No motor shunting is provided.

2. Batteries

a. Exide UD-466 unitized batteries. price at time of dlvy

✱ b. 100-amp battery charging receptacle provided in electrical cabinet.

✱ 3. Ground Relay Reset

Barco automatic ground relay reset is provided, with reset for the automatic device in the electrical cabinet.

Basic manual reset button is retained on control stand.

Ground relay reset is trainlined to AAR standard.

4. Traction Motor Modifications

a. Traction motor lockouts-not provided

✱ b. Traction motor bottom inspection covers are hinged at one end and bolted at the opposite end.

c. Traction motor support bearings with~~out~~ rings.

5. Other Control Modifications

$720 (rechk price) up from $320

✱ a. Manual power reduction, trainlined per AAR standards; three-position switch - off, MU, Single.

✱ b. Faraday alarm buzzer located bottom right side of control stand (outside of control stand).

$1440

× c. 18KW AC auxiliary generator replaced basic 10KW DC auxiliary generator.

F. Engine Modifications

1. Filters

a. Primary (carbody) Filters

1) Basic inertial separator, providing filtered air to engine filter and generator-motor blower. Customer specifically requires AAF elements.

DENVER & RIO GRANDE
EMD ORDER 786264

F. Engine Modifications - Cont'd.

1. Filters

a. Primary (carbody) Filters

2) Inertial Blower Motor Protection

Basic circuit breaker prevents motor overload. * Indicating light on engine control cabinet indicates tripped circuit breaker, resulting from motor overload condition.

b. Engine Air Filters

AAF "bag-type" engine air filters.

reselection * 2. Oil Pan

Oversize oil pan increases lube oil capacity to 396 gallons.

3. Engine Protection

Low water-high crankcase pressure engine shutdown device provided basically with 20 PSI pressure cap.

4. Spark Arrester Manifold

No such device is required in conjunction with turbocharger engine exhaust emissions.

The turbocharger screen assembly includes, basically, a trap box attached to the outer body at the bottom which collects small debris.

#440 * Inspection plate

5. Engine Turning Jack

None required.

#1015 * 6. Fuel Oil Preheater - use new EMD std equipt & arrangement

a. General 62-64 model provided. Ship direct to D&RGW. (Discuss standardization of fuel oil preheater with customer)

b. Preheater is piped into pressure side of fuel pump.

7. Other Engine Modifications/Features

a. Positive starting gear engagement, eliminating drive pinion abutments is basic. - Slow crank feature * 1500

#530 * b. Bolted-on engine stubshaft is provided.

c. Low engine idle speed is basic.

DENVER & RIO GRANDE
EMD ORDER 786264

G. Trucks

Basic single shoe truck design with the following features and modifications:

1. Gear Ratio

62:15 gear ratio provides full horsepower to 65 mph and a minimum continuous speed of 11.1 mph.

2. Wheels

a. Forty-inch D-40 wrought steel wheels with AAR contour machined witness groove is basic. Class BR Wheels.

3. Axles

a. Axles with 6-7/8" journal diameter provided basically.

*135 b. Axles splined at both ends ~~one end only~~.

4. Journal Boxes

a. Hyatt JEM journal boxes, new only, supplied basically.

b. Oil Fill Cups

Plugs replace basic JEM quick-fill oil cups.

c. Grind relief on all corners of journal box guides.

5. Slack Adjusters

EMD pin type.

~~6. Inspection Covers~~ (already covered)

~~a. Traction Motor~~

~~Traction motor bottom inspection covers are hinged at one end and bolted at the opposite end.~~

7. Huck Fasteners

Not used in truck construction.

DENVER & RIO GRANDE
EMD ORDER 786264

H. Cab Modifications

$440 1. Cab Seats

a. One Coach and Car (~~1291702-D~~ 1598106) slide-rail-mounted cab seat with backrest and armrests is provided at engineer's position.

b. Two Coach and Car slide-rail-mounted cab seats are mounted on the observer's side and include the following:

   1) Padded armrests.

   2) Special seat cushion material.

   3) Special seat cushion contour (front radius is greater than rear radius).

   4) Dark green color.

c. The three cab seats are equipped with D&RGW monograms.

$1955 * 2. Water Cooler

Ajax #85 water cooler (includes two-gallon basic bottle and Dixie Model 1444-S cup dispenser). See Item H.11 - AAR/EMD Phase II Clean Cab for location of water cooler and cup dispenser.

*4180 3. Speed Indicator/Recorder

no longer basic - Barco now std -

Chicago-Pneumatic grease-lubricated speed recorder provided with 0-90 mph black face dial with barrel type keys. - put cable on right side plus double splined axles from previous.

* 4. Cab Heaters

Electric cab heaters replace basic hot water units. Application requires that basic 10KW auxiliary generator be replaced with one of 18KW capacity.

The switch controlling the right side strip heater is a round knob so that engineer can distinguish strip heater switch from the headlight switch at night.

* 5. Cab Flooring

Rough surface 3/8" thick Benelex covering the plywood base.

* 6. Awnings

Prime metal awning on both sides of cab.

DENVER & RIO GRANDE
EMD ORDER 786264

H. Cab Modifications - Cont'd.

* 7. Wind Deflectors

Salem 651-M-1 full length mirror wind deflectors front only on both sides.

8. Doors, Windows, Glass

* a. Lexan polycarbonate glazing replaces basic glass in sliding cab windows, both sides.

* 1180 b. Elcon National "Triplex" glazing replaces basic glass in all front and rear cab windows. Type V

9. Cab Controls

a. Basic single control station.

b. Controller

Basic AAR-approved "three-handle" arrangement, with separate controls for power and dynamic brake control.

10. Ammeter

Basic zero-center ammeter indicates motor amps under power with clockwise deflections from the "zero-center" position and braking current with counter-clockwise deflections.

11. Other Cab Modifications

Phase II AAR/EMD Clean Cab is provided basically and includes the following:

1) 22" cab door closing handles.

2) Flexible rubber hinge guard for cab doors.

3) Head bump pads above doors.

4) Cover over windshield wiper motors.

5) Rubber handle on wiper motors.

6) Sealed number boxes inside cab.

7) Outside access to number boxes.

8) Paddes sun visor on both engineer's & fireman's side.

9) Rounded cab window latches.

H. Cab Modifications - Cont'd.

11. Other Cab Modifications

10) Rubber handle on horn valve.

11) Short hood lengthened seven (7) inches.

12) Separate toilet compartment in nose with access door, floor drain, outside air ventilator and light.

13) Alcove in short hood for water cooler accessible through a full height opening in the cab front partition. Cup dispenser is located in alcove. A light is provided in this compartment.

14) Recessed stairs into short hood.

15) Recessed conductor's emergency brake valve in left hand front cab partition.

16) Rounded defroster ducting on front partition.

17) Recessed cab ceiling light and switches and recessed windshield wiper valves.

18) Modified AAR control stand providing "built-in" location above the 26C brake valve for mounting radio control head (also requires offset independent brake valve handle - see Item A.1.e.2.

I. Radio

Radio or provision for radio is provided by the customer.

J. Carbody

1. Hood Arrangement

a. The short hood end of the locomotive is considered the front.

b. A stenciled "F" is located on the side sill near the end of each side to identify that end as the front.

c. Short Hood

Basic low profile short hood.

DENVER & RIO GRANDE
EMD ORDER 786264

J. Carbody - Cont'd.

2. End Arrangement

a. No. 1 (front) end

1730 * 1) EMD large snowplow pilot part no. 8475665 less doors.

2) Sidesteps

Basic 14-inch clearance.

b. No. 2 (rear) end

1) Hose storage rack not required-flat plate only

2) Sidesteps

Basic 14-inch clearance.

c. Coupler/Draft Gear

Basic NC391 draft gear and "E" coupler with alignment control at both ends.

3. Lights

The basic complement of lights, specifically including twin-sealed beam headlights at both ends, is supplemented with the following lights and lighting modifications:

1705 * a. Translite Model 20585 DWFV twin-sealed beam white signal light, including inching feature, provided in low short hood. Slow oscillation is provided.

4. Fire Extinguishers

Basic complement, consisting of the two 20-pound Ansul dry powder extinguishers, one in the cab, the other in the engine compartment.

5085 * 5. Toilet

+ D&RGW
Hotshit
system

H-8-4-80

Microphor Model LF310 stainless steel toilet w/integral sequence and H8 digestive system, including chlorinator, water tank and immersion heater. The following EMD Part Numbers apply:

Treatment System, including chlorinator - 8484976, 8484977
8484978, 8484979
8484980, 8484981
8484982.

See Item H.11. - AAR/EMD Phase II
Clean Cab for location of toilet.

J. Carbody - Cont'd.

6. Lifting and Jacking Devices

a. Jacking Pad/Cable Sling

Basic arrangement only, consisting of one combination sling/jacking pad welded to the underframe side sill, near the longitudinal bolster center.

$275 * b. Supplemental Lifting Eyes

Lifting eyes in end sheet are provided, both ends.

7. Locomotive Weight

Nominal loaded weight, including all modifications and supplies is 390,000 pounds. The standard manufacturing tolerance may result in a plus or minus 5,000 pound variation from the nominal weight. Variation between trucks does not exceed 5,000 pounds.

Locomotive scale weight record, EMD Form 420D, to be furnished for each locomotive.

8. Clearance

a. Height

No special height restrictions.

9. Cooling System

*$22,840 a. Low level cooling air intake (tunnel modification). T-2

b. Twenty (20) psi pressure cap replaces basic seven (7) psi pressure cap.

10. Other Carbody Modifications

a. Handrails follow contour of platform on No. 2 (rear) end and are positioned 2-3/8" inboard of the platform edge.

* b. Offset provided inside underframe-mounted handrail adjacent to rear ladder steps, both sides of locomotive.

* c. Curved horizontal grab iron provided at rear of long hood, engineer's side only. Grab iron extends from side of long hood around to rear and is at same height as underframe-mounted handrails.

* d. Slot provided in side of long hood at No. 2 end (rear) ladder steps, both sides of locomotive.

NOTE: Slots permit light from the basic rear end platform lights to illuminate the ladder steps.

J. Carbody - Cont'd.

10. Other Carbody Modifications

e. Type "F" glad-hand connections replace the basic "rattlesnake" connections for water fill at the following two locations:

1) Cooling system water fill.

2) Toilet water fill, both sides of locomotive.

f. Basic steplights in place of ground lights.

K. Fuel Tank

*$5280 1. Capacity

Optional fuel tank provides 4,000-gallon capacity.

* ~~2. Filler Pipes~~ included

One additional fuel filler pipe on each side, i.e., total of four. included

~~3.~~ Gauges included

extended, maybe extra

a. Qualitrol dial-type gauges, both sides.

b. One eight-inch fill gauges adjacent to each basic filler pipe, i.e., total of two.

* 4. Automatic Fuel Fill Adapters (Shutoff Device)

~~None provided.~~ Add Buckeye - external adapter 45° fitting — out tank top

~~*[illegible]~~ L. Styling and Painting

In accordance with drawings prepared by EMD and approved by D&RGW. The following are specifically included:

1. Front End Identification

The front end of the locomotive is identified as such with a stenciled "F" applied to the side sill on both sides.

2. ACI Labels

Not provided.

3. Number Boxes

Number panels are of fiberglass construction and include white numbers on black background.

✓

L. Styling and Painting - Cont'd.

*1715 4. Polyurethane Paint

A two-color polyurethane paint scheme calls for application of polyurethane paint to all exterior carbody surfaces. Specifically not receiving the polyurethane paint are the fuel tank, air reservoirs trucks and other undercarriage surfaces which receive basic enamel.

5. Identification

Road and Serial Numbers are as follows:

ROAD NUMBERS	SERIAL NUMBERS
5398 - 5413 open -	

M. Shipment

1. Consignment and Routing

In accordance with written instructions furnished by railroad.

*695 2. Operating Supplies

Locomotive is shipped with full charge of Arco GL Supreme lube oil.

N. Drawings

Standard set of drawings provided.

1. Half size Mylar of the following:
   - a. Physical schematic wiring diagram.
   - b. Cable and conduit layout.
   - c. Wire running list.
   - d. Setting chart.
   - e. Schematic air piping.

NOTE: The physical schematic wiring diagram, the cable and conduit layout and the location diagrams of the wire running list are on one drawing.

2. Full size sepia of remainder.

Roger R Klatt
Roger R. Klatt
Sales Engineer

RRK/rr

GM

Electro-Motive

Division of General Motors Corporation
La Grange, Illinois 60525 U.S.A.
(312) 485-7000

ADDRESS REPLY TO:
1000 JORIE BOULEVARD
SUITE 138
OAK BROOK, ILLINOIS 60521
PHONE 312-654-6710

February 9, 1976

Mr. J. E. Timberlake
Director of Unit Train Oper.
Denver & Rio Grande Western Railroad Company
P.O. Box 5482
Denver, Colorado 80217

Dear Jack:

Per your phone request to John Singleton, please find enclosed two copies of PT-262 table which shows the Trailing Load-Speed-Grade for your GP40 locomotives. I understand from John that you requested such tables with freight cars weighing 133 tons; however, the only immediate tables available are for freight cars weighing 132 tons. I hope these will be of assistance to you.

Sorry to have missed you during my "maiden voyage" to Denver last month; however, I will be periodically returning to the scene of my former crimes so look forward to seeing you then.

Very truly yours,

L.R. Beck

L. R. Beck
District Manager
Northwestern Region

LRB/rg
Attach.

4/8/74

J G Harris

SD40-2

COST

8

EMD 365,715

R G. 3785

369500

FRT. 2500

372500

ELECTRO-MOTIVE DIVISION
General Motors Corporation
March 12, 1974

MEMORANDUM OF CONFERENCE

covering

DENVER AND RIO GRANDE WESTERN RAILROAD
FIFTEEN (15) SD40-2 LOCOMOTIVES
EMD ORDER A-74636

Representatives of Electro-Motive Division and the Denver and Rio Grande Western Railroad met in the latter's Denver, Colorado office on March 5, 1974 to establish detailed specifications for construction of the subject locomotives.

In attendance were:

DENVER AND RIO GRANDE WESTERN RAILROAD	ELECTRO-MOTIVE DIVISION
G. L. Christofano	L. R. Beck
J. G. Harris	R. T. Sharp
W. A. Henderson	J. C. Singleton
G. H. McDonald	C. E. Welsh
S. A. Silverman	
P. D. Starr	

This Memorandum of that meeting records mutual agreement and understanding relative to the following:

I. GENERAL

Fifteen (15) 3000 horsepower SD40-2 locomotives will be constructed for the Denver and Rio Grande Western Railroad in accordance with General Motors Locomotive Specification 8087 dated January 3, 1972.

II. DELIVERY

At the time of the meeting it was understood that delivery of the fifteen (15) SD40-2 locomotives was tentatively scheduled to commence in 4th quarter, 1974. EMD agrees to notify Denver and Rio Grande Western should changes become necessary.

III. LOCOMOTIVE OPTIONS AND MODIFICATIONS

A. Locomotive options and modifications were defined by mutual agreement at the meeting. It was understood that EMD would release options and modifications for production accordingly.

The attached Specification Supplement dated March 11, 1974, is used by EMD to release construction details for production. It is presented to the Denver and Rio Grande Western for review, comment and approval with the understanding that changes in construction details will be made by mutual agreement.

III. **LOCOMOTIVE OPTIONS AND MODIFICATIONS** (Cont'd.)

B. Open Items

With the release of the March 11, 1974 Opening Specification Supplement, all construction details with the exception of those listed below are considered to be defined and released for production:

1. ~~Relocation of Nathan M3R1 horn~~. SAME AS STD.

2. Batteries. EXIDE MVE-25

3. Denver and Rio Grande Western monograms on cab seats.
supplied by seat manufacturer.

Russell T. Sharp
Russell T. Sharp
Sales Engineering

RTS:vb
Attachment

ELECTRO-MOTIVE DIVISION
General Motors Corporation
La Grange, Illinois 60525
March 12, 1974

OPENING SPECIFICATION SUPPLEMENT

covering

DENVER AND RIO GRANDE WESTERN RAILROAD
FIFTEEN (15) SD40-2 LOCOMOTIVES
EMD ORDER A-74636

I. GENERAL

General Motors Locomotive Specification 8087, covering the basic 3000 horsepower SD40-2 locomotive model, is amended by mutual agreement to include options and modifications detailed below. This Specification Supplement releases the locomotives herein defined for production.

II. LOCOMOTIVE OPTIONS AND MODIFICATIONS

A. AIR SYSTEM

1. Air Brakes

Basic 26L brake schedule with "F" control valve with the following features and modifications:

a. Provision for service application including P2A valve and PC switch.

b. Safety control from single foot pedal with warning whistle and time delay.

c. Overspeed control with warning whistle, time delay and PC knockdown provided, includes suppression of service application.

1) Overspeed control set for 67 mph.

d. Provision for compatible operation with locomotives equipped with 6RL brakes not provided.

e. Other air brake modifications

1) Independent brake valve pressure set for 90 psi on the gauge.

2) Removable independent brake valve handle, not offset.

3) Removable automatic brake valve handle.

4) Conductor's brake valve in cab provided basically.

A. AIR SYSTEM

1. e. Other air brake modifications (Cont'd.)

    5) J1.8-18 proportioning valve (180% relay valve) is provided.

2. Air Compressor

    a. Basic 3-cylinder water cooled compressor.

    b. Air compressor synchronization provided with dual contact pressure switch.

    c. Filter is Air Maze.

3. Gauges and Fittings

    a. Salem 4-1/2" air gauges - green dial.

    b. Salem test fittings.

    c. Salem test fitting in line to compressor gauge and unloader switch.

4. Main Reservoir

    a. Filters

    Basic Salem 818 and 824 centrifugal filters located after the No. 1 and No. 2 main reservoirs, filter air for the auxiliaries and the air brake respectively.

    b. Drain valves

    Salem 880 automatic drain valves on both main reservoirs.

    c. Actuation of filters and drain valves

    Blowdown of filters and automatic drain valves is actuated by Salem 872 timer.

5. Warning Devices

    a. Bell

    Basic application.

    b. Horn

    Nathan M3R1 horn is provided. The horn location is open.

B. SANDING

1. Control

    a. Basic inboard-outboard sanding.

B. SANDING

1. Control (Cont'd.)

b. Basic electric control only. Assignment of trainline control wires covered under C.3.b. below.

c. Modular system of wheel slip control provided basically.

d. Automatic sanding from any emergency brake application. Refer to Item C.1.a.

e. Switches

1) Manual (directional) sanding switch is latching type.

2) Lead axle sanding switch is basic latching type.

3) Indicating light shows all sanding conditions except wheel slip sanding.

2. Sand Traps and Related Devices

a. A total of eight basic 273 sand traps including integral rotary shutoff valve is provided.

3. Sand Box

a. Capacity

Increased sand box capacity of 36 cu. ft. per end.

4. Other Sanding Modifications

a. Sanding air supply taken from No. 2 main reservoir instead of No. 1.

C. MULTIPLE UNIT CONTROL

Multiple unit control is provided basically. The following modifications/features are provided:

1. Provision for Emergency

a. A-1 charging valve, including two No. 8 vent valves, control the following functions:

1) Power knockdown from any emergency.

2) Automatic 60-second timed sanding from any emergency.

3) Brake pipe break-in-two protection.

C. MULTIPLE UNIT CONTROL (Cont'd.)

2. Cables

a. Two 27 point EMD jumper cables nine feet long.

b. Second jumper cable shipped separately. Ship to:

Denver and Rio Grande Western Railroad Co.
Mr. P. R. Dimitroff
Material Manager
8th Avenue and Osage Street
Denver, Colorado

c. S.P. type jumper cable support mounted with open side of support away from end sill, both ends.

3. Receptacle

a. Single 27 point Pyle National WWRF27K receptacle at each end.

b. Pin assignments same as on prior D&RGW Order 72715, specifically:

1) Sanding directional control on #23 and emergency on #5.

2) Manual power reduction on #26 and #27.

4. Provision for Manual Transition

Modification to permit operation of manual transition units in consist not required.

5. Air End Connections

a. Basic duplex air end connections.

b. Aeroquip MU hoses at both ends on one side of coupler only.

c. Smith vented ball type cutout cocks.

D. DYNAMIC BRAKES

Extended range dynamic brakes with the following features and modifications:

1. Interlock

PC switch used for Type II, non-reapplying interlock, i.e., the locomotive brake will not reapply after release of a dynamic brake application which had earlier caused release of an automatic service application. The independent air brake function is not affected by the dynamic brake interlock.

D. DYNAMIC BRAKES (Cont'd.)

2. Control

a. Standard potential control trainlined on #24 wire.

b. Standard EMD system in which braking effort is regulated by motor field excitation current--i.e., with any given position of control handle (throttle), braking effort increases as speed increases up to the 700 amp maximum.

3. Load Test Provision

Provision is made for load testing locomotive on its own dynamic brake grids.

4. Grid Protection Circuit

Special circuit is provided to nullify dynamic brake in response to grid blower motor failure.

5. Other Dynamic Brake Modifications

a. DB1 solenoid located on brake valve side of dual ported cutout cock.

b. D&RGW special dynamic brake cutout switch circuitry.

c. Air system is modified to provide individual unit bleed-off of dynamic brake interlock per D&RGW drawing dated 12/14/72.

E. ELECTRICAL CONTROL MODIFICATIONS

1. Transmission

Motors are connected in series-parallel for starting and make transition to full parallel. No motor shunting is provided.

2. Batteries

a. Batteries are open.

b. 100 amp battery charging receptacle provided in electrical cabinet.

3. Ground Relay Reset

Basic manual reset only, trainlined on point #1.

4. Traction Motor Modifications

a. Traction motor lockouts

No provision is made for locking out individual motors.

E. ELECTRICAL CONTROL MODIFICATIONS (Cont'd.)

5. Other Control Modifications

a. Manual power reduction, trainlined on points #26 and #27; three-position switch - off, MU, single.

b. Faraday alarm buzzer located bottom right side of control stand.

F. ENGINE MODIFICATIONS

1. Filters

a. Primary (carbody) filters

1) Basic inertial separator, providing filtered air to engine filter and generator-motor blower. Customer specifically requires AAF elements.

2) Inertial blower motor protection

Basic circuit breaker prevents motor overload. Indicating light on engine control cabinet indicates tripped circuit breaker resulting from motor overload condition.

b. Engine air filters

AAF "bag-type" engine air filters

2. Oil Pan

Oversize oil pan increases lube oil capacity to 396 gallons.

3. Engine Protection

Low water-high crankcase pressure engine shutdown device provided basically.

4. Spark Arrester Manifold

No such device is required in conjunction with turbocharged engine exhaust emissions.

The turbocharger screen assembly includes, basically, a trap box attached to the outer body at the bottom which collects small debris.

5. Engine Turning Jack

None required.

6. Fuel Oil Preheater

General V-58 model provided.

F. ENGINE MODIFICATIONS (Cont'd.)

7. Other Engine Modifications

Positive starting gear engagement, eliminating drive pinion abutments, is basic.

G. TRUCKS

Basic single shoe truck design with the following features and modifications:

1. Gear Ratio

62:15 gear ratio provides full horsepower to 65 mph and a minimum continuous speed of 11.1 mph.

2. Wheels

a. Forty inch D-40 wrought steel wheels with AAR contour. Machined witness groove is basic.

3. Axles

a. Axles with 6-7/8" journal diameter provided basically.

b. Axles splined at one end only.

4. Journal Boxes

a. Hyatt JEM journal boxes, new only, supplied basically.

b. Oil fill cups

Basic JEM quick-fill oil cups are provided.

5. Slack Adjusters

EMD pin type.

6. Inspection Covers

a. Traction motor

Hinged type, permitting quick access.

7. Huck Fasteners

Not used in truck construction.

8. Other Truck Modifications

a. Double coil springs capable of loads up to 70,000 lb. axle loading.

H. CAB MODIFICATIONS

1. Cab Seats

a. One Coach and Car (1291702-D) slide-rail-mounted cab seat with backrest and armrests is provided at engineer's position.

b. Two basic type slide-rail-mounted cab seats with armrests are mounted on the observer's side.

2. Water Cooler

Ajax #685 water cooler (includes spare one gallon bottle and cup dispenser).

3. Speed Indicator/Recorder

Chicago Pneumatic grease lubricated speed recorder provided with 0-90 mph black face dial.

4. Cab Heaters

Electric cab heaters replace basic hot water units. Application requires that basic 10KW auxiliary generator be replaced with one of 18KW capacity.

5. Cab Flooring

Rough surface 3/8" thick Benelex covering the plywood base.

6. Awnings

Prime metal awning on both sides of cab.

7. Wind Deflectors

Salem 651-M-1 full length mirror wind deflectors front only on both sides.

8. Doors, Windows, Glass

Basic arrangement is provided.

9. Cab Controls

a. Basic single control station.

b. Controller

Basic AAR approved "three-handle" arrangement, with separate controls for power and dynamic brake control.

10. Ammeter

Basic zero-center ammeter indicates motor amps under power with clockwise deflections from the "zero-center" position and braking current with counter-clockwise deflections.

I. RADIO

No radio or provision for radio is provided.

J. CARBODY

1. Hood Arrangement

a. The short hood end of the locomotive is considered the front.

b. A stencilled "F" is located on the side sill near the end of each side to identify that end as the front.

c. Short hood

Basic low profile short hood.

2. End Arrangement

a. No. 1 (front) end

1) EMD large snowplow pilot replacing basic footboards.

2) Sidesteps

Basic 14 inch clearance.

b. No. 2 (rear) end

1) Footboards deleted but hose storage rack retained.

2) Sidesteps

Basic 14 inch clearance.

c. Coupler/draft gear

Basic NC391 draft gear and "E" coupler with alignment control at both ends.

3. Lights

The basic complement of lights, specifically including twin sealed beam headlights at both ends, is supplemented with the following lights and lighting modifications:

a. Mars twin sealed beam white signal light, including inching feature, provided in low short hood.

4. Fire Extinguishers

Basic complement, consisting of two 20 lb. Ansul dry powder extinguishers, one in the cab, the other in the engine compartment.

J. CARBODY (Cont'd.)

5. Toilet

Microphor model LF300 stainless steel toilet with H8 digestion system including chlorinator, water tank and immersion heater. The following EMD part numbers apply:

Stainless steel hopper and water sequence valve	-	8481455
Treatment system including chlorinator	-	8484976 8484977 8484978 8484979 8484980 8484981 8484982

6. Lifting and Jacking Devices

a. Jacking pad/cable sling

Basic arrangement only, consisting of one combination sling/jacking pad welded to the underframe side sill, near the longitudinal bolster center.

b. Supplemental lifting eyes

Lifting eyes in end sheet are provided, both ends.

7. Locomotive Weight

Nominal loaded weight including all modifications and supplies is 390,000 pounds. The standard manufacturing tolerance may result in a ± 4,000 pound variation from the nominal weight. Variation between trucks does not exceed 4,000 pounds.

Locomotive Scale Weight Record, EMD Form 420D, is to be furnished for each locomotive.

8. Clearance

a. Height

No special height restrictions.

9. Cooling System

Low level cooling air intake (tunnel modification).

K. FUEL TANK

1. Capacity

Optional fuel tank provides 4000 gallon capacity.

K. **FUEL TANK** (Cont'd.)

2. **Filler Pipes**

One additional fuel filler pipe on each side, i.e., total of four.

3. **Gauges**

a. Pneumercator dial-type gauges, both sides.

b. One eight-inch fill gauge adjacent to each basic filler pipe, i.e., total of two.

4. **Automatic Fuel Fill Adapters (Shutoff Device)**

None provided.

L. **STYLING AND PAINTING**

In accordance with drawings prepared by EMD and approved by D&RGW. The following are specifically included:

1. **Front End Identification**

The front of the locomotive is identified as such with a stencilled "F" applied to the side sill on both sides.

2. **ACI Labels**

ACI labels - on plates; stanchion mounted are provided on both sides.

3. **Number Boxes**

Number panels are of fiberglass construction and include white numbers on black background.

4. **Polyurethane Paint**

A two-color polyurethane paint scheme calls for application of polyurethane paint to all exterior carbody surfaces. Specifically not receiving the polyurethane paint are the fuel tank, air reservoirs, trucks and other undercarriage surfaces which now normally receive basic enamel.

5. **Identification**

Road and serial numbers are as follows:

Road Numbers	Serial Numbers
5341 - 5355	74636-1 thru 74636-15

M. SHIPMENT

1. Consignment and Routing

In accordance with written instructions furnished by railroad.

2. Operating Supplies

Locomotive is shipped with full charge of Arco GL Supreme lube oil.

N. DRAWINGS

Standard set of drawings provided.

1. Half size Mylar of the following:
   - a. Physical schematic wiring diagram
   - b. Cable and conduit layout
   - c. Wire running list
   - d. Setting chart
   - e. Schematic air piping
2. Full size sepia of remainder.

Russell T. Sharp
Russell T. Sharp
Sales Engineering

RTS:vb
cc: Std. Dist.

GM
ELECTRO-MOTIVE DIVISION

Electro-Motive
Division of General Motors Corporation
La Grange, Illinois 60525 (312) 485-7000

February 25, 1974

EMD Order 74636

Mr. P. D. Starr
Chief Mechanical Officer
Denver & Rio Grande Western Railroad
P.O. Box 5482
Denver, Colorado 80217

Dear Mr. Starr:

The following is supplemental to our phone conversation of last week regarding the increased length of the SD40-2 locomotive made necessary by the tunnel modification. The following brief table shows the curve negotiation and pertinent lengths of the SD40-2 compared to the SD40-T2:

	SD40-2	SD40-2 with tunnel modification
Single unit curve negotiation	30° or 193 ft. radius	25° or 230 ft. radius
Two units coupled in multiple	22° or 262 ft. radius	21° or 274 ft. radius
Single unit coupled to a 50 ft. car	16° or 359 ft. radius	16° or 359 ft. radius
Distance between bolster centers	43 ft. 6 in.	45 ft. 5 in.
Length over end plates	64 ft. 8 in.	66 ft. 6 in.
Length over pulling faces	68 ft. 10 in.	70 ft. 8 in.

The current standard SD40-2 has been lengthened over the earlier SD40/SD45 in order to accomodate the new high traction truck and provide space for additional fuel. You will recall that the SD45 locomotives on the Rio Grande are 65'8" over the pulling faces and the distance between bolster centers is 40'.

I have also included one copy of the standard SD40-2 locomotive specification. The SD40-T2 is identical to this except for the increased lengths and alterations resulting from the tunnel modification. We will be prepared to discuss this modification in detail during the settlement of detail meeting scheduled for March 5.

Very truly yours,

L. R. Beck

L. R. Beck
District Manager
Central Region

LRB/rg
Attach.
cc: Mr. J. E. Timberlake - Attach.

From Rwy Fuel & Opng Officers Assoc bi monthly bulletin
dated July-Aug 1974

COP

FUEL CONSUMPTION-EMD LOCOMOTIVES
Gallons Per Hour

Throttle	GP/SD7	GP/SD9	GP/SD18	GP20	SD24	GP30	GP/DD/SD35
8	93.1	108.1	108.0	116.0	144.0	124.9	143.6
7	75.3	82.2	88.0	86.0	106.3	102.1	124.3
6	59.6	67.7	70.0	69.0	80.6	75.2	96.2
5	45.7	51.5	54.5	54.8	61.2	61.1	72.1
4	33.5	36.8	39.7	41.5	44.5	44.9	51.2
3	23.4	23.6	25.0	28.3	30.2	31.0	34.9
2	14.5	13.4	15.0	14.5	17.5	18.9	20.9
1	6.5	4.4	8.0	6.3	5.5	7.2	11.0
Idle	3.5	3.5	3.5	3.5	3.2	3.5	5.0

	SD45	SD/GP40	SD/GP39	SD/GP38	SW1500	SW1000
8	194.0	167.7	128.2	122.4	92.6	60.2
7	171.5	145.8	102.6	102.8	79.6	49.7
6	127.0	108.5	80.1	83.1	62.1	39.9
5	91.7	79.0	58.2	63.8	52.5	31.0
4	67.5	57.2	40.0	46.8	38.6	22.2
3	47.8	41.4	26.0	31.4	25.2	13.4
2	28.1	24.9	15.1	16.0	11.5	6.1
1	9.8	7.4	6.5	7.0	6.5	5.0
Idle	6.0	5.5	4.0	5.0	3.8	3.0
Dyn.Br.	25.0	25.0	25.0	25.0	-	-

FUEL CONSUMPTION - GENERAL ELECTRIC XR LOCOMOTIVES
Gallons Per Hour

Throttle	U18B	U23B&C	U30B&C	U33B&C	U36B&C
8	103.0	112.1	149.2	162.7	177.1
7	84.7	92.5	126.7	138.0	150.1
6	72.2	80.6	102.0	110.3	119.0
5	56.0	63.5	81.0	86.9	94.2
4	42.0	47.7	61.5	65.3	68.8
3	23.5	27.0	34.1	36.4	39.2
2	15.9	17.3	22.2	23.0	24.2
1	11.3	11.9	15.9	15.9	16.2
Idle	3.5	3.5	5.0	5.0	5.0
Dyn.Br.	20.0	20.0	26.0	26.0	26.0

OPERATING RULES

Several years ago the standard Operating Rules definition for engine was changed as follows:

Engine - A unit propelled by any form of energy used in train or yard service

TO

Engine - A unit propelled by any form of energy.or a combination of

Locomotive Owership 1/1/75

Series	Type	Units	Service	Year Built	Builder	Class	Engine HP Rating Per Unit	Cooling Water Gals. Per Unit	Fuel Oil Gals. Per Unit	Lube Oil Gals. Per Unit
130 - 139	SW-1200	10	S	1965	EMD	DE B-B 61	1,200(2)	230	930	165
140 - 146	SW-1000	7	S	1966	"	DE B-B 60	1,000(1)	190	1,100	135
147 - 149	SW-1000	3	S	1968	"	DE B-B 60	1,000(1)	190	1,100	135
3001 - 3013	GP-30	11	R-S	1962	"	DE B-B 62	2,250(3)	227	2,600	220
3014 - 3028	GP-30	15	R-S	1963	"	DE B-B 62	2,250(3)	227	2,600	220
3029 - 3038	GP-35	10	R-S	1964	"	DE B-B 62	2,500(3)	275	2,600	243
3039 - 3050	GP-35	12	R-S	1965	"	DE B-B 62	2,500(3)	275	2,600	243
3051 - 3068	GP-40	17	R-S	1966	"	DE B-B 65	3,000(4)	254	3,600	396
3069 - 3080	GP-40	12	R-S	1967	"	DE B-B 65	3,000(4)	254	3,600	396
3081 - 3085	GP-40	5	R-S	1969	"	DE B-B 65	3,000(4)	254	3,600	396
3086 - 3093	GP-40	8	R-S	1971	"	DE B-B 65	3,000(4)	254	3,600	396
3094 - 3115	GP40-2	22	R-S	1972	"	DE B-B 65	3,000(4)	254	3,600	396
3116 - 3128	GP40-2	13	R-S	1974	"	DE B-B 65	3,000(4)	275	3,600	396
5108 -	GP-7	1	R-S	1952	"	DE B-B 60	1,500(3)	230	1,200	200
5300 - 5304	SD-7	5	R-S	1953	"	DE C-C 89	1,500(3)	260	2,400	200
5305 - 5314	SD-9	10	R-S	1957	"	DE C-C 89	1,750(3)	260	2,400	200
5315 - 5324	SD-45	10	R-S	1967	"	DE C-C 93	3,600(20)	288	4,000	466
5325 - 5340	SD-45	16	R-S	1968	"	DE C-C 93	3,600(20)	288	4,000	466
5341 - 5355	SD40T-2	15	R-S	1974	"	DE C-C 92	3,000(4)	275	4,000	396
o5356 - 5373	SD40T-2	18	R-S	1975	"	DD C-C 92	3,000(4)	275	4,000	396
5902 - 5904	GP-9	3	R-S	1955	"	DE B-B 60	1,750(3)	230	1,200	200
5911 - 5914	GP-9	4	R-S	1955	"	DE B-B 60	1,750(3)	230	1,200	200
5921 - 5924	GP-9	4	R-S	1955	"	DE-B-B 60	1,750(3)	230	1,200	200
5931 - 5934	GP-9	4	R-S	1956	"	DE B-B 61	1,750(3)	230	1,600	200
5941 - 5944	GP-9	4	R-S	1956	"	DE B-B 61	1,750(3)	230	1,600	200
5951 - 5954	GP-9	4	R-S	1956	"	DE B-B 61	1,750(3)	230	1,600	200
x5762 - 5763	F-9	2	F	1955	"	DE B-B 59	1,750(3)	215	1,200	200
5771	F-9	1	F	1955	"	DE B-B 60	1,750(3)	230	1,200	200

Total Units - 246

Series		Units	Built	Builder	Steam Gen. (Cap.-lbs.)	Boiler Water Gals.	Fuel Oil Gallons per unit	Total Loaded Wt. on rail
250,251 -	Steam Generator Units in passenger service	2	1953	Baldwin &DRGW	4,500	8,200	1,200	251,600
250, 253 -	Steam Generator Units in passenger service	2	1965	Alco &DRGW	6,500	6,730	1,200	244,680
X5762,5763 -	Locomotive Units with Steam Generators	2	1955	EMD	4,635	1,400	1,200	247,390
5771		1	1955	EMD	None	600	1,200	247,706

All units have 40-inch diameter wheels

x - Units with heating generators

o - Units on order for 1975 delivery

Diesel Engine Data			
HP	Code =	Cylinders	Bore & Stroke in inches
1,000	(1)	8	9-1/16 x 10
Etc.	(2)	12	8-1/2 x 10
Etc.	(3)	16	8-1/2 x 10
Etc.	(4)	16	9-1/16 x 10
Etc.	(20)	20	9-1/16 x 10

Class Designation		
D E	B-B or C-C	61, 60, etc.
Diesel Electric	Truck B = 2 Driving Axles C = 3 Driving Axles	Tractive Effort in Thousands - Lbs.

Revised 1-1-75

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE GENERAL MOTORS LOCOMOTIVES ILLINOIS

May 15, 1972

Mr. J. E. Timberlake
Director of Unit Train Operation
Denver & Rio Grande Western R.R. Co.
P. O. Box 5482
Denver, Colorado 80217

Dear Mr. Timberlake:

In reply to your request of last Friday, we are pleased to attach PT Tables Nos. 263 and 264 for SD45 and SD40 locomotives hauling 132 ton cars.

If you have further requests for this type of data kindly advise Bob Beck or our department and we will be pleased to furnish this information to you.

Sincerely,

H. W. Barber

H. W. Barber, Manager
Product Application Section

HWB:mh
Attachments

ZIP CODE 60525

EMD

GM

Electro-Motive
Division of General Motors Corporation
La Grange, Illinois 60525 (312) 485-7000

April 24, 1974

Mr. J. E. Timberlake
Director Unit Train Operations
Denver & Rio Grande Western Railroad
P.O. Box 5482
Denver, Colorado 80217

Dear Mr. Timberlake:

Attached is a copy of the SD40-2 locomotive outline and general arrangement drawing 8493961. You will note that this drawing includes the tunnel modification.

Very truly yours,

John C Singleton
J. C. Singleton
District Manager
Central Region

JCS/rg
Attach.

Knight
Tank car dope

75 tons
37½ lite } 23 M gal tank insulated

112 =

12 GP'S @ 300 386 ✓
15 SD-40'S @ 366,160 ✓ } 3rd quart 74

235 100T 16M'S. 3rd quarter 75 ✓ (35 inclg Apache)
+ space for 200 1st quarter 76 ✓

12 GP Sept

5 SD Oct

+8 GP - Oct. or fall back 1st quarter

1- Firm 6 mos prior to dlvy — no penalty

Oct - dlvy

Must have firm order | 6 months from dely   Oct - firm order April.

cancel | 5 months - from dlvy

4

3

2

1

0

3073

	SD-40	SD-40T-2	
LOPF	68'10"	70'8"	
EH	15'7$\frac{3}{16}$	15'7$\frac{3}{16}$	+1$\frac{1}{2}$"
EW	10'3$\frac{1}{8}$	10'3$\frac{1}{8}$	
Wt-	195 Tons	195 tons	

Colo Spng - needs ~~525M~~ this yr.
525M

74 -

cx Edna 300M vs 175
Florence 200M

Portland 120M vs - 0

ex NRG -

UP&L - 3 units 7 days wk.
ck type of unit needed in tonnage

30 car train

Wk out GP-40's on
MoP 2nd section

UP&L needs 4 units (GP-40) ahead
RA - CG no helper
CG - KY 1 helper or 5 ahead

or

2 SD 45' 100%
1 SD-45' helper - headend
part time
} Carbon

2 SD 45 100%
2 GP-40 helper
} Godsby

5 SD's
12 GP-40'-2
8-
4 ~~600~~

Jones

UP&L 30 30 cars

5 SD-40's

3 SD45 equivalents - Braztah = 4 GP-40-2

9000 adj (3) =

132 × 30 = 3960
28
3988
1125/unit = 4 units

135 adj × 30 = 4050 (3)
− 31 cab adj (3)

$\frac{4081}{900}$ = 5 units GP-40. hd end -

AEP = ~~5 SD-40's~~
3 SD-45's = 4 GP-40's = ~~4 GP's~~

UP&L = 4 GP-40's (+ helper when to Gadsdy) = 4 GP's × 3 GP-40 head end - 100%

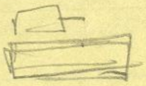
Moffate = 600 M addition - if NRG cranks out =

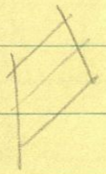
Fall 4 SD-45's + GP-40 = 7 GP-40's 4 GP's 1 scratch for 3

~~[illegible] SD-40's~~

8

$ 2,000,000 74 AEP
$ 1,500,000 74 PSC
~~1,000,00~~
500 M Cole Spring & Ideal
500 M escalation
50 M NCA





5 SD-40's

3 SD-45 = 4 GP-40's

4 GP =

SD-45 = 3 GP - 3 days -

Moapa was using about 5 =

35 = ~~14 units~~ 5 5 4

4 units 2 Craig 2 Pbg

+ 5

12 GP-4 —

8 =

2

6 —

15

375'

18th

18' 10"
4' 40
20' 00

$\boxed{24\ 40}$

24'40"

Mon Wed Fri. Sun Tues Thur

Tues,
AM

8'1
5 SD-40
3- SD-45
equiv

3 SD 45 @ 375 — 1,125,000

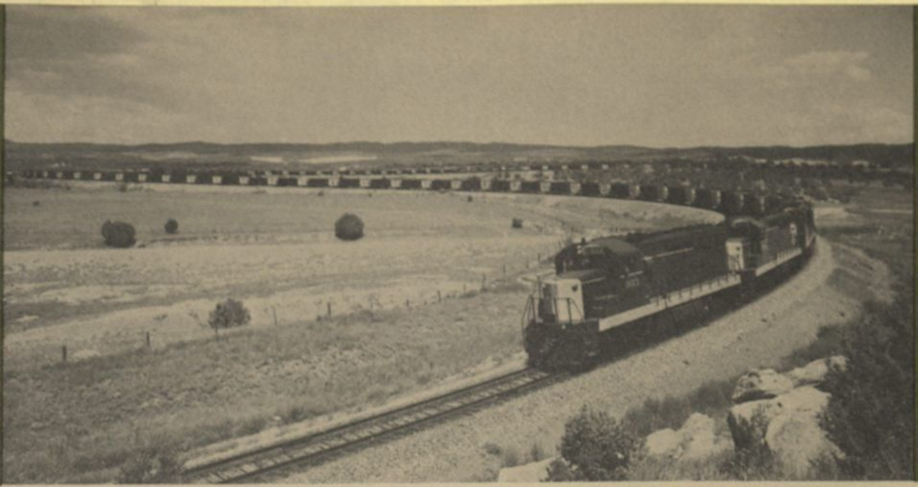
5 SD 40's @ 350 =

MaC | 5 SD 40 -
3 SD-45 = 4 GP-40's

UP&L 2 SD-45 – 1 GP- } help
2 GP-40's }

NRG 4 SD-40's – 1 GP-40

2 GP-40 help Tab
Denver & Div.



TRACTIVE EFFORT FORMULAE

11/16/72

To calculate the required strength of a coupler and yoke for any particular application, it is necessary to determine the train consist, grades and curves to be traversed, locomotive tractive effort, etc.

Maximum coupler force is directly related to the number of cars being pulled by one motive power consist. If motive power is made up of more than one consist and is distributed in the train, the maximum coupler force is less than the total tractive effort and will depend on the exact train makeup and the operating conditions.

While the following formulae, adapted from Marks' Engineering Handbook, have been used for these calculations, service tests have shown that surges of 50% in locomotive continuous tractive effort can exist from wheelslip and grab, and that these surges should be considered in evaluating coupler and yoke strength requirements.

General

To accelerate a train, forces must be applied to balance those forces which oppose train movement and to provide additional force to accelerate the train. Opposing forces are: Train resistance (friction, air, rail bending); grade resistance (due to lifting the train weight in ascending a grade); curve resistance (friction between wheel flange and rails on curves).

Train Calculation Formulae

Continuous coupler pull force (lbs) = Trailing tons x total train resistance (lbs/ton)

Maximum continuous coupler force = 1.5 x Continuous coupler pull force

$$\text{Trailing tons} = \frac{\text{tractive effort available (lbs)}}{\text{total train resistance (lbs/ton)}} - \text{Loco wt (tons)}$$

Train Resistance

A great many formulae have been devised to permit calculation of the resistance values of different types and weights of trains. The most satisfactory of these are the Davis formulae: (Ref. Marks' Engineering Handbook)

$$\text{Freight Car Resistance lbs/ton} = 1.3 + \underbrace{\frac{29}{W}}_{\textit{Journal}} + \underbrace{.045V}_{\textit{Flange}} + \underbrace{\frac{.0005AV^2}{WN}}_{\textit{Wind}}$$

W = Average tons/axle • N = Number of axles • V = Speed in mph • A = Frontal area in sq ft (A = 100 for house and open top cars and 120 for piggyback cars)

Based on current knowledge, freight car *starting* resistance is as follows:

8 lbs/ton — roller bearings with slack in train
16 lbs/ton — roller bearings without slack in train
15 lbs/ton — plain bearings with slack in train
30 lbs/ton — plain bearings without slack in train

Grade Resistance

The per cent grade is the number of feet rise per 100 ft length of track. On a 1 per cent grade a ton (2000 lbs) must be lifted 1 ft for each 100 ft the train advances. The resultant grade resistance will equal

$$\frac{2000 \text{ lbs} \times 1 \text{ ft}}{100 \text{ ft}} = 20 \text{ pounds/ton/1\% of grade}$$

Curve Resistance

Degree of curve is the number of degrees of central angle subtended by a 100-ft chord measured on track center line. An approximate relationship between radius of curvature and degree of curve is:

$$\text{Radius of curvature in ft} = \frac{5730}{\text{Degree of curve}}$$

$$\text{Degree of curve} = \frac{5730}{\text{Radius in ft}}$$

Curve resistance = 0.8 lbs/ton/degree of curve

Adhesion

Is the ratio of a horizontal force to a vertical force, or in railroad terms is the equivalent to

$$\frac{\text{available tractive force (lbs)}}{\text{total locomotive weight on rail (lbs)}}$$

and is expressed in a per cent ratio. Experience has indicated that a *starting* adhesion of 25 to 30 per cent can be attained, while running adhesions above 20 per cent are almost impossible to hold unless under extremely good rail conditions.

Sample Calculations

The following calculations give the maximum coupler force for a 100 car train pulled by a single consist of locomotives at the head end.

Cars: 100 ton capacity each (131.5 tons gross) • Total wt 131.5 x 100 = 13,150 tons
Track curve: 10 degrees • Track grade: 1% ascending

1. Starting force on level track assuming normal slack in train:
   Force = 13,150 tons x 8 lb/ton = 105,200 lb
2. Running at 15 mph on level track:

   $$R = 1.3 + \frac{29}{W} + .045\,V + \frac{.0005\,AV^2}{WN}$$

   R = resistance lb/ton • N = number of axles (4 per car)
   W = 32.8 average tons/axle • V = speed 15 mph • A = frontal area 100 ft^2

   $$R = 1.3 + \frac{29}{32.8} + (.045 \times 15) + \frac{.0005 \times 100 \times 15^2}{32.8 \times 4}$$

   R = 2.95 lb/ton • Force = 2.95 x 13,150 = 38,800 lb
3. Resistance offered by 10° curve:
   Force = 13,150 tons x 10° x 0.8 lb/ton/degree of curve = 105,200 lb
4. Resistance offered by 1% grade:
   Force = 13,150 tons x 1% x 20 lb/ton/1% = 263,000 lb
   Curve resistance and/or grade resistance must be added to either or both condition 1 and 2, if they are applicable, to determine maximum coupler force.
5. Maximum coupler force
   a. Maximum starting coupler force

Level track resistance	105,200 lb
10° Curve resistance	105,200 lb
1% Grade resistance	263,000 lb
Maximum starting coupler force	473,400 lb

   b. Maximum-continuous running coupler force

Level track resistance at 15 mph	38,800 lb
10° Curve resistance	105,200 lb
1% Grade resistance	263,000 lb
	407,000 lb

Maximum continuous running coupler force = 407,000 lb x 1.5 = 610,500 lb

Using the strongest coupler knuckle available, we recommend that the maximum continuous coupler force not exceed 500,000 lb. Therefore, for the example given, the maximum continuous running coupler force of 610,500 lb must be reduced by distributing the motive power throughout the train. If the motive power were broken into two consists with half the locomotives at the head and half 50 cars back in the train, with proper synchronization, the maximum coupler force would be only one half of 610,500 lb (305,250 lb) because only 50 cars would be pulled by each locomotive consist.

Trak 214

Max Tbg-Top 1.83 long - $1\frac{1}{4}$ miles Pbg Yampa

Haybro - Pbg 1.8 $\frac{1}{3}$ mile longest at Pallas Summit

Max Dot-MN 1.33

1.8 short $\frac{1}{4}$ at Gyp

1.98 into MN - ~~same dist~~. $\frac{1}{4}$ mile.

288,225

20 X Grade in % + 3 lbs/ton moving resistance × act train trailing tons ← 362,100

rating is Too high

74 000

59

1655 act/unit

4 units good for ± 300 000 TE

37 000

265,000

12,000 ~~[illegible]~~ act on 1%
with 4 45's
acct adhesion at 19½%

Curve
Compensation on grades
reduce grade by .04 to .05%
For each degree of
curvature.

Thus multiply degree of
curvature by .04% or .05%
& compare resesult with
grade on each side of
curve to determine whether
& how much compensation.

LECTRO-MOTIVE DIVISION, GENERAL MOTORS CORPORATION NP 5858

GENERAL MOTORS LOCOMOTIVES
PRODUCT APPLICATION SECTION
ELECTRO-MOTIVE DIVISION
LA GRANGE, ILLINOIS

Speed	6.8
Grade	
.00	30871.
.10	17142.
.20	11840.
.30	9029.
.40	7287.
.50	6102.
.60	5243.
.70	4592.
.80	4082.
.90	3672.
1.00	3334.
1.10	3051.
1.20	2811.
1.30	2605.
1.40	2426.
1.50	2268.
1.60	2129.
1.70	2006.
1.80	1895.
1.90	1795.
2.00	1704.
2.10	1622.
2.20	1546.
2.30	1477.
2.40	1414.
2.50	1355.
2.60	1300.
2.70	1250.
2.80	1203.
2.90	1158.
3.00	1117.

2. Paragraph (a) of this Article provides only for the use of a second engine in prohibitive double-heading territory for speed purposes and the NOTE following paragraph (f) defines the rating or capacity of the heaviest engine propelling the train as being the amount of tonnage that has been handled previously or would be handled without assistance at ordinary rate of speed. In territories where the time table tonnage ratings for dead freight trains is the only rating used in connection with any freight trains, if freight trains are ordinarily handled with this amount of tonnage for specified classes of engines, then that defines the tonnage that can be handled in a double-header train when applied to the heaviest engine of the two engines used. (See B-154-48). On the other hand, in territories where symbol or manifest trains are operated with train tonnage less than that specified in the time table for dead freight trains, the train tonnage ratings so established for such manifest trains and ordinarily handled with a single engine becomes the measure for a double-header train. (1st Division Awards 9367, 9368, 9471, 9472, 9473). Award 9473 denied compensation claimed as not supported by Agreement.

Article 43

2. Paragraph (a) of this Article provides only for the use of a second engine in prohibitive double-heading territory for speed purposes and the NOTE following paragraph (f) defines the rating or capacity of the heaviest engine propelling the train as being the amount of tonnage that has been handled previously or would be handled without assistance at ordinary rate of speed. In territories where the time table tonnage ratings for dead freight trains is the only rating used in connection with any freight trains, if freight trains are ordinarily handled with this amount of tonnage for specified classes of engines, then that defines the tonnage that can be handled in a double-header train when applied to the heaviest engine of the two engines used. (See B-154-48). On the other hand, in territories where symbol or manifest trains are operated with train tonnage less than that specified in the time table for dead freight trains, the train tonnage ratings so established for such manifest trains and ordinarily handled with a single engine becomes the measure for a double-header train. (1st Division Awards 9367, 9368, 9471, 9472, 9473). Award 9473 denied compensation claimed as not supported by Agreement.

Speed	18.0	20.0
Grade		
.00	13608.	11866.
.10	8248.	7293.
.20	5897.	5244.
.30	4576.	4081.
.40	3730.	3332.
.50	3142.	2810.
.60	2709.	2424.
.70	2378.	2128.
.80	2115.	1893.
.90	1903.	1702.
1.00	1727.	1545.
1.10	1579.	1412.
1.20	1453.	1299.
1.30	1344.	1201.
1.40	1250.	1116.
1.50	1166.	1041.
1.60	1092.	974.
1.70	1027.	915.
1.80	967.	862.
1.90	914.	814.
2.00	866.	770.
2.10	821.	730.
2.20	781.	694.
2.30	744.	660.
2.40	710.	629.
2.50	678.	601.
2.60	649.	574.
2.70	621.	550.
2.80	596.	527.
2.90	572.	505.
3.00	550.	485,

PT-9
7-29-63

GENERAL MOTORS LOCOMOTIVES
PRODUCT APPLICATION SECTION
ELECTRO-MOTIVE DIVISION
LA GRANGE, ILLINOIS

PT -9
7-29-63

Electro-Motive Division
General Motors Corporation
La Grange, Illinois

TRAILING LOAD - GRADE - SPEED
2500 HP Model GP35 Locomotive
62:15 Gear Ratio - Locomotive Weight 130 Tons
130 Ton Cars

Speed	6.8	7.0	7.5	8.0	8.5	8.9	10.0	11.0	12.0	15.0	18.0	20.0	Speed
Grade	TRAILING LOAD - U.S. Tons												Grade
.00	30871.	29758.	28481.	27034.	25709.	24647.	22175.	19985.	18298.	15840.	13608.	11866.	.00
.10	17142.	16551.	15909.	15164.	14481.	13928.	12644.	11486.	10600.	9393.	8248.	7293.	.10
.20	11840.	11439.	11012.	10513.	10055.	9683.	8820.	8036.	7438.	6654.	5897.	5244.	.20
.30	9029.	8725.	8406.	8031.	7687.	7407.	6758.	6166.	5716.	5138.	4576.	4081.	.30
.40	7287.	7042.	6788.	6488.	6212.	5988.	5468.	4993.	4632.	4176.	3730.	3332.	.40
.50	6102.	5897.	5686.	5435.	5206.	5019.	4585.	4188.	3887.	3511.	3142.	2810.	.50
.60	5243.	5067.	4886.	4672.	4475.	4314.	3943.	3602.	3344.	3024.	2709.	2424.	.60
.70	4592.	4438.	4280.	4092.	3920.	3780.	3454.	3156.	2930.	2652.	2378.	2128.	.70
.80	4082.	3945.	3805.	3638.	3485.	3360.	3070.	2805.	2604.	2358.	2115.	1893.	.80
.90	3672.	3548.	3422.	3271.	3134.	3021.	2761.	2522.	2341.	2121.	1903.	1702.	.90
1.00	3334.	3221.	3107.	2970.	2845.	2743.	2506.	2288.	2124.	1925.	1727.	1545.	1.00
1.10	3051.	2948.	2843.	2718.	2603.	2509.	2292.	2093.	1942.	1760.	1579.	1412.	1.10
1.20	2811.	2716.	2619.	2503.	2397.	2311.	2111.	1927.	1787.	1620.	1453.	1299.	1.20
1.30	2605.	2516.	2426.	2319.	2221.	2140.	1954.	1783.	1654.	1499.	1344.	1201.	1.30
1.40	2426.	2343.	2259.	2159.	2067.	1992.	1818.	1659.	1538.	1394.	1250.	1116.	1.40
1.50	2268.	2191.	2112.	2018.	1932.	1862.	1699.	1549.	1436.	1301.	1166.	1041.	1.50
1.60	2129.	2056.	1982.	1894.	1813.	1747.	1594.	1453.	1346.	1219.	1092.	974.	1.60
1.70	2006.	1937.	1867.	1783.	1707.	1644.	1500.	1367.	1266.	1146.	1027.	915.	1.70
1.80	1895.	1829.	1763.	1684.	1612.	1552.	1415.	1289.	1194.	1081.	967.	862.	1.80
1.90	1795.	1733.	1670.	1595.	1526.	1470.	1339.	1220.	1129.	1021.	914.	814.	1.90
2.00	1704.	1645.	1585.	1514.	1448.	1394.	1270.	1156.	1070.	968.	866.	770.	2.00
2.10	1622.	1565.	1508.	1440.	1377.	1326.	1208.	1099.	1017.	919.	821.	730.	2.10
2.20	1546.	1492.	1438.	1372.	1313.	1264.	1150.	1046.	968.	874.	781.	694.	2.20
2.30	1477.	1425.	1373.	1311.	1253.	1206.	1098.	998.	922.	833.	744.	660.	2.30
2.40	1414.	1364.	1314.	1254.	1198.	1153.	1049.	953.	881.	795.	710.	629.	2.40
2.50	1355.	1307.	1259.	1201.	1148.	1105.	1005.	912.	843.	760.	678.	601.	2.50
2.60	1300.	1254.	1208.	1152.	1101.	1059.	963.	874.	807.	728.	649.	574.	2.60
2.70	1250.	1205.	1160.	1107.	1058.	1017.	924.	839.	774.	698.	621.	550.	2.70
2.80	1203.	1160.	1116.	1065.	1017.	978.	888.	806.	743.	670.	596.	527.	2.80
2.90	1158.	1117.	1075.	1025.	979.	942.	855.	775.	715.	643.	572.	505.	2.90
3.00	1117.	1077.	1037.	988.	944.	907.	823.	746.	688.	619.	550.	485,	3.00

GENERAL MOTORS LOCOMOTIVES
PRODUCT APPLICATION SECTION
ELECTRO-MOTIVE DIVISION
LA GRANGE, ILLINOIS

Electro-Motive Division
General Motors Corporation
La Grange, Illinois

PT - 9A
7-29-63

TRAILING LOAD - GRADE - SPEED
2500 HP Model GP35 Locomotive
62:15 Gear Ratio - Locomotive Weight 130 Tons
130 Ton Cars

Speed	25	30	35	40	45	50	55	60	65	70	71		Speed
Grade	TRAILING LOAD - U.S.Tons												Grade
.00	8766.	6644.	5184.	4155.	3373.	2775.	2303.	1918.	1601.	1339.	1281.		.00
.10	5564.	4343.	3480.	2858.	2372.	1990.	1681.	1423.	1205.	1021.	978.		.10
.20	4057.	3209.	2604.	2164.	1815.	1539.	1313.	1121.	956.	815.	782.		.20
.30	3181.	2534.	2070.	1731.	1461.	1246.	1069.	917.	785.	672.	645.		.30
.40	2608.	2085.	1710.	1436.	1216.	1041.	895.	770.	661.	567.	544.		.40
.50	2204.	1766.	1452.	1221.	1037.	889.	766.	660.	567.	486.	466.		.50
.60	1904.	1528.	1257.	1059.	899.	772.	665.	573.	492.	422.	404.		.60
.70	1672.	1342.	1105.	931.	791.	679.	585.	504.	432.	370.	354.		.70
.80	1488.	1194.	983.	828.	703.	603.	519.	447.	383.	327.	313.		.80
.90	1338.	1073.	882.	743.	631.	540.	465.	399.	341.	290.	278.		.90
1.00	1213.	972.	799.	672.	570.	488.	419.	359.	306.	260.	248.		1.00
1.10	1108.	887.	728.	612.	518.	443.	379.	324.	276.	233.	222.		1.10
1.20	1018.	814.	667.	560.	473.	404.	345.	294.	249.	210.	200.		1.20
1.30	940.	751.	614.	515.	434.	370.	315.	268.	226.	189.	180.		1.30
1.40	872.	696.	568.	475.	400.	340.	289.	245.	205.	171.	162.		1.40
1.50	813.	647.	527.	440.	370.	313.	265.	224.	187.	155.	146.		1.50
1.60	760.	604.	491.	409.	343.	289.	245.	205.	171.	140.	132.		1.60
1.70	712.	565.	459.	381.	318.	268.	226.	189.	156.	127.	120.		1.70
1.80	670.	530.	429.	356.	297.	249.	209.	174.	143.	115.	108.		1.80
1.90	631.	498.	403.	333.	277.	231.	193.	160.	130.	104.	98.		1.90
2.00	596.	470.	379.	312.	259.	215.	179.	147.	119.	94.	88.		2.00
2.10	564.	444.	357.	293.	242.	201.	166.	136.	109.	85.	79.		2.10
2.20	535.	420.	336.	276.	227.	187.	154.	125.	100.	77.	71.		2.20
2.30	508.	398.	318.	260.	213.	175.	143.	116.	91.	69.	63.		2.30
2.40	483.	377.	301.	245.	200.	164.	133.	106.	83.	62.	56.		2.40
2.50	460.	358.	285.	231.	188.	153.	124.	98.	75.	55.	50.		2.50
2.60	439.	341.	270.	218.	177.	143.	115.	90.	68.	49.	44.		2.60
2.70	419.	325.	256.	206.	166.	134.	107.	83.	62.	43.	38.		2.70
2.80	401.	309.	243.	195.	156.	125.	99.	76.	56.	37.	33.		2.80
2.90	384.	295.	231.	185.	147.	117.	92.	70.	50.	32.	28.		2.90
3.00	367.	282.	220.	175.	139.	110.	85.	64.	44.	27.	23.		3.00

8-17-66

TRAILING LOAD - SPEED - GRADE TABLE

3000 HP SD40 LOCOMOTIVE 62/15 GEAR RATIO

LOCOMOTIVE WEIGHT 197 TONS

FREIGHT CAR WEIGHT 100 TONS

SPEED	9.5	10.2	10.5	11.0	11.9	13.0	15.0	20.0	25.0
GRADE	TRAILING LOAD - SHORT TONS								
.00	9999	9999	9999	9999	9999	9999	9999	9999	9802
.10	9999	9999	9999	9999	9999	9999	9999	8516	6429
.20	9999	9999	9999	9999	9999	9757	8488	6217	4757
.30	9999	9522	9216	8909	8302	7578	6612	4878	3759
.40	8246	7751	7503	7257	6767	6182	5402	4001	3095
.50	6941	6526	6318	6112	5702	5210	4557	3383	2623
.60	5985	5628	5449	5271	4919	4496	3934	2923	2268
.70	5255	4942	4784	4629	4319	3948	3455	2568	1993
.80	4679	4400	4259	4121	3846	3515	3076	2285	1773
.90	4213	3962	3835	3710	3462	3163	2768	2055	1594
1.00	3828	3599	3484	3371	3145	2873	2513	1864	1444
1.10	3505	3295	3189	3086	2878	2629	2298	1703	1317
1.20	3230	3036	2938	2843	2651	2420	2115	1565	1209
1.30	2993	2813	2722	2633	2455	2241	1957	1446	1115
1.40	2787	2619	2534	2450	2284	2084	1819	1342	1032
1.50	2606	2448	2368	2290	2134	1946	1698	1250	960
1.60	2445	2297	2221	2148	2001	1824	1590	1169	895
1.70	2302	2162	2091	2021	1882	1715	1494	1096	838
1.80	2174	2041	1973	1908	1776	1618	1408	1030	786
1.90	2058	1931	1867	1805	1680	1529	1330	971	739
2.00	1953	1832	1771	1712	1593	1449	1259	918	696
2.10	1857	1742	1684	1627	1513	1376	1195	869	657
2.20	1770	1659	1604	1549	1440	1309	1136	824	622
2.30	1689	1584	1530	1478	1374	1248	1082	783	589
2.40	1615	1514	1462	1412	1312	1191	1032	745	559
2.50	1547	1449	1400	1352	1255	1139	986	709	530
2.60	1483	1389	1341	1295	1202	1091	943	677	504
2.70	1424	1333	1287	1243	1153	1046	903	646	480
2.80	1369	1281	1237	1194	1108	1004	866	618	458
2.90	1318	1233	1190	1148	1065	964	831	592	436
3.00	1269	1187	1146	1106	1025	927	799	567	417
RATING	1/4HR	1/2HR	1 HR	CONTINUOUS					
ADH. %	23.4	22.1	21.4	20.8	19.5	18.0	16.0	12.3	10.0

9999 INDICATES TRAILING LOAD EXCEEDING 10,000 TONS.
TONNAGES CAN BE HANDLED ONLY IF ADHESION IS ATTAINABLE.

PRODUCT APPLICATION SECTION
ELECTRO-MOTIVE DIVISION
LA GRANGE, ILLINOIS

GENERAL MOTORS LOCOMOTIVES

PT135

ELECTRO-MOTIVE DIVISION, GENERAL MOTORS CORPORATION NP 5858

8-17-66

TRAILING LOAD - SPEED - GRADE TABLE

3000 HP SD40 LOCOMOTIVE 62/15 GEAR RATIO

LOCOMOTIVE WEIGHT 197 TONS

FREIGHT CAR WEIGHT 100 TONS

SPEED	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	71.0
GRADE	TRAILING LOAD - SHORT TONS								
.00	7430	5765	4580	3719	3029	2489	2059	1707	1371
.10	5010	3988	3242	2688	2231	1864	1565	1315	1070
.20	3756	3026	2489	2086	1749	1475	1249	1056	866
.30	2989	2424	2007	1693	1427	1209	1028	873	718
.40	2471	2012	1671	1414	1196	1017	866	737	607
.50	2098	1711	1424	1208	1023	870	742	631	519
.60	1816	1483	1235	1048	888	755	644	547	449
.70	1596	1303	1085	921	780	663	564	479	391
.80	1419	1158	964	817	691	587	498	421	343
.90	1274	1039	863	731	617	523	443	373	302
1.00	1153	938	779	659	555	469	396	332	267
1.10	1050	853	707	597	501	422	355	296	236
1.20	962	780	645	543	455	381	319	265	210
1.30	886	716	591	496	414	346	288	238	186
1.40	819	660	543	455	378	314	261	213	165
1.50	759	611	501	418	346	286	236	191	146
1.60	707	567	463	385	318	261	214	172	129
1.70	659	527	429	356	292	239	194	154	114
1.80	617	492	399	329	269	218	176	138	100
1.90	578	459	371	305	247	200	159	123	87
2.00	543	430	346	283	228	182	144	110	75
2.10	511	403	323	263	210	167	130	97	64
2.20	482	378	302	244	194	152	117	86	54
2.30	455	356	282	227	179	139	105	75	45
2.40	430	335	264	211	165	127	94	66	36
2.50	407	315	247	196	152	115	84	57	28
2.60	385	297	232	183	140	105	74	48	21
2.70	365	280	217	170	129	95	66	40	14
2.80	347	265	204	158	118	85	57	33	7
2.90	329	250	191	147	108	76	49	26	1
3.00	313	236.	179	136	99	68	42	19	0

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE GENERAL MOTORS LOCOMOTIVES ILLINOIS

December 21, 1971

Mr. J. E. Timberlake
Director Unit Train Operations
Denver & Rio Grande Western Railroad
P.O. Box 5482
Denver, Colorado 80217

Dear Mr. Timberlake:

The following is in response to your recent request for speed tractive effort curves and dynamic braking curves for late model locomotives. Attached is one copy each of the following curves:

	GP35	GP40	SD45
Speed - tractive effort	SC-2555	SC-2787	SC-2617
Dynamic braking effort	SC-2562	SC-2563	SC-2570

If I can be of further assistance to you, I would be most happy to do so.

Very truly yours,

L.R. Beck

L. R. Beck
District Manager
Central Region

LRB/rg
Attach.

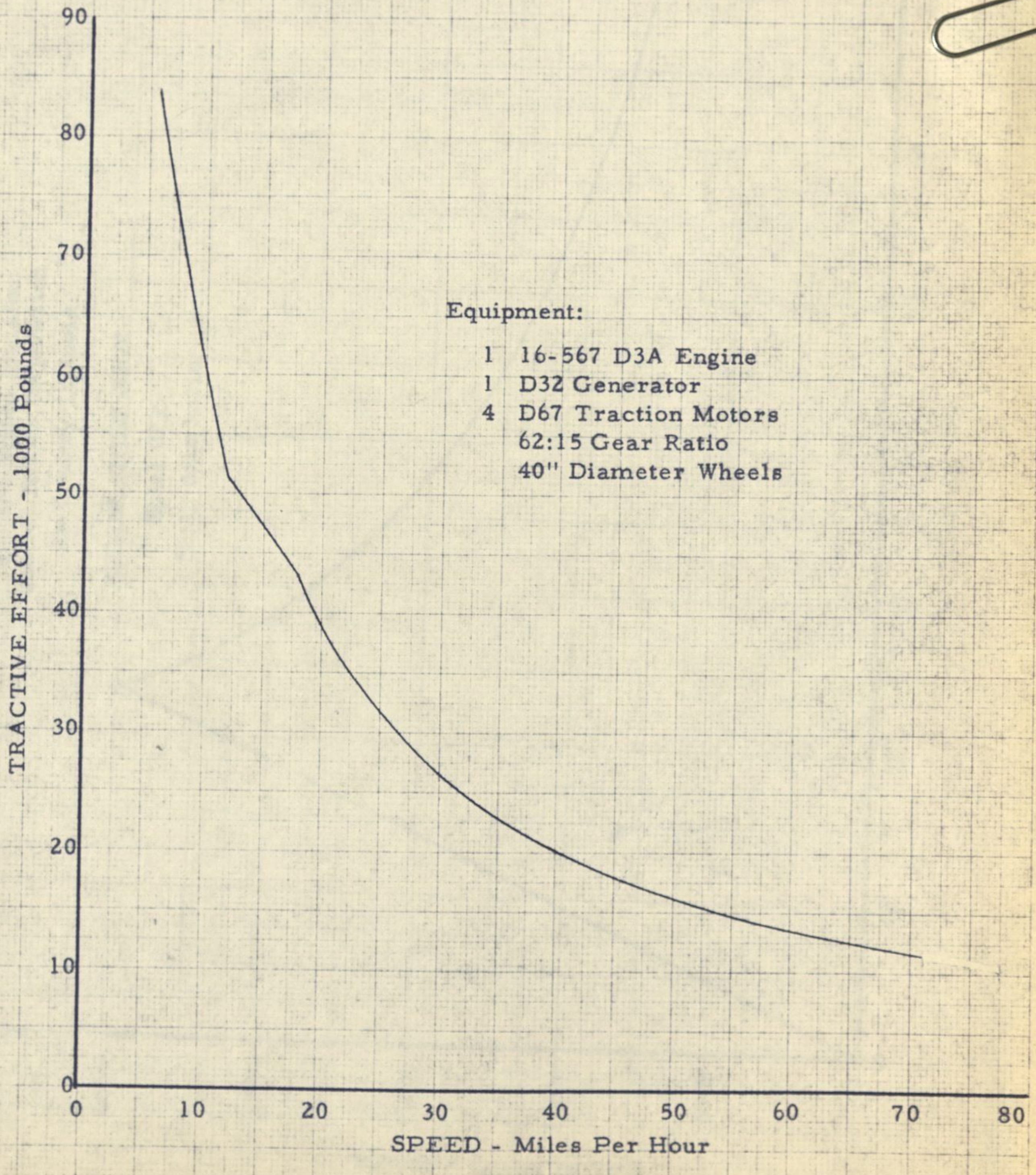
cc: D. J. Butters - Attach.
P. D. Starr - "

ZIP CODE 60525

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

4 12-63

SPEED - TRACTIVE EFFORT CURVE
2500 HP Model GP35 Locomotive



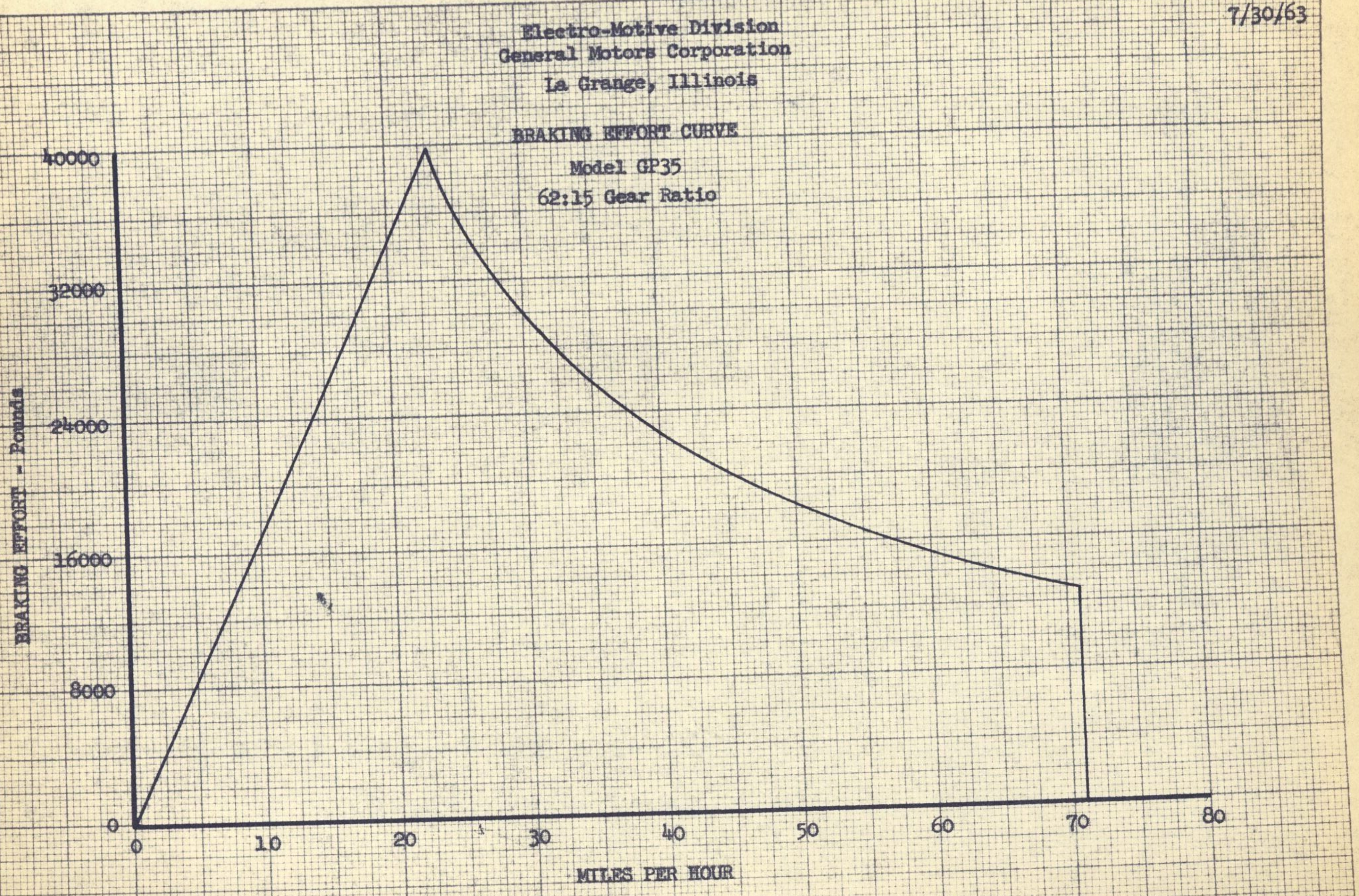
Equipment:

1 16-567 D3A Engine
1 D32 Generator
4 D67 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

FREDERICK POST COMPANY
301TR20 CROSS SECTION 20X20 PER INCH

7/30/63



Electro-Motive Division
General Motors Corporation
La Grange, Illinois

BRAKING EFFORT CURVE
Model GP35
62:15 Gear Ratio

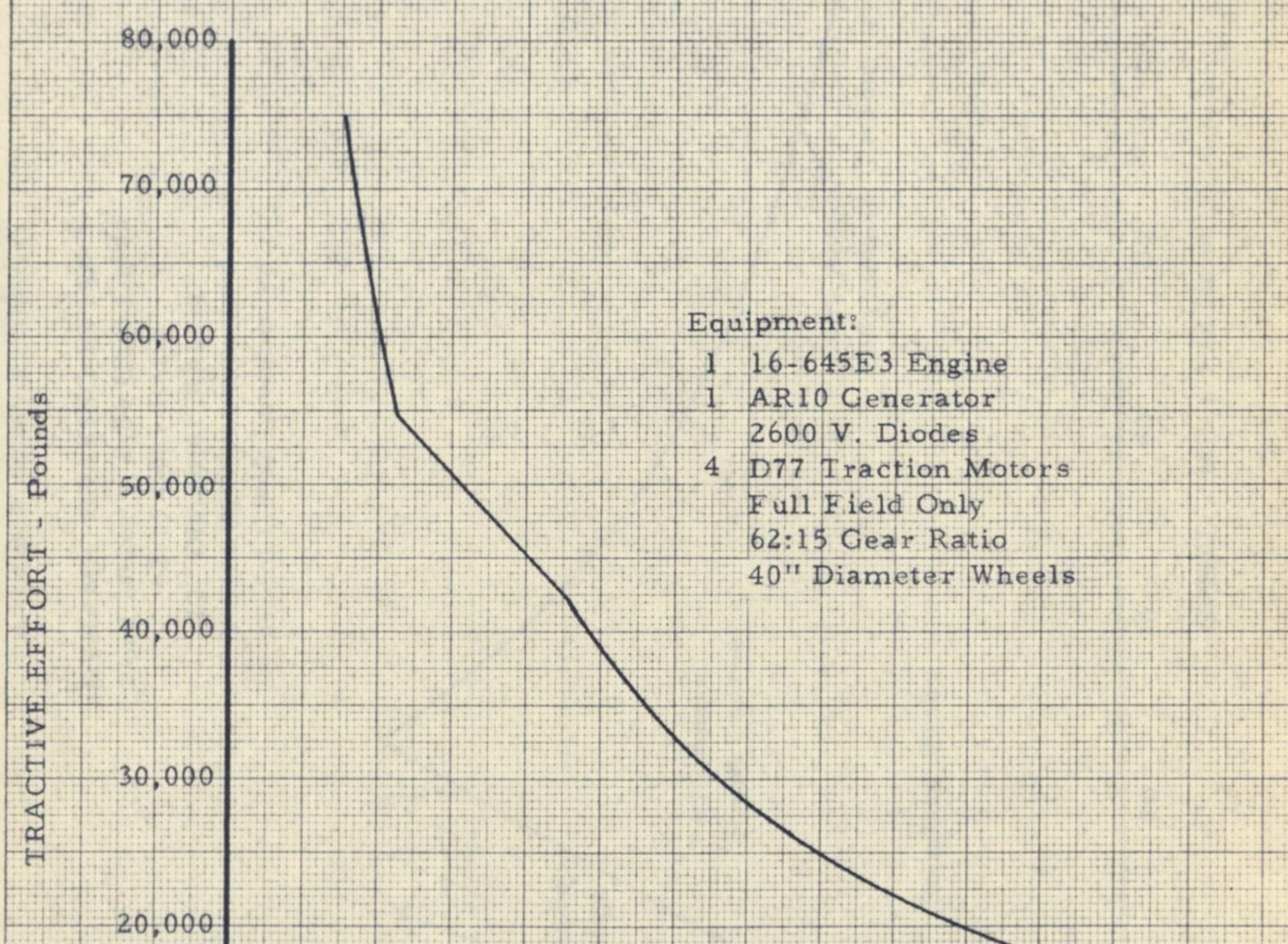
SC2562

Product Application

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

6-26-70
Rev. B

SPEED - TRACTIVE EFFORT
3000 HP Model GP40 Locomotive
Performance Control Option 1



Equipment:
1 16-645E3 Engine
1 AR10 Generator
2600 V. Diodes
4 D77 Traction Motors
Full Field Only
62:15 Gear Ratio
40" Diameter Wheels

SC-2787

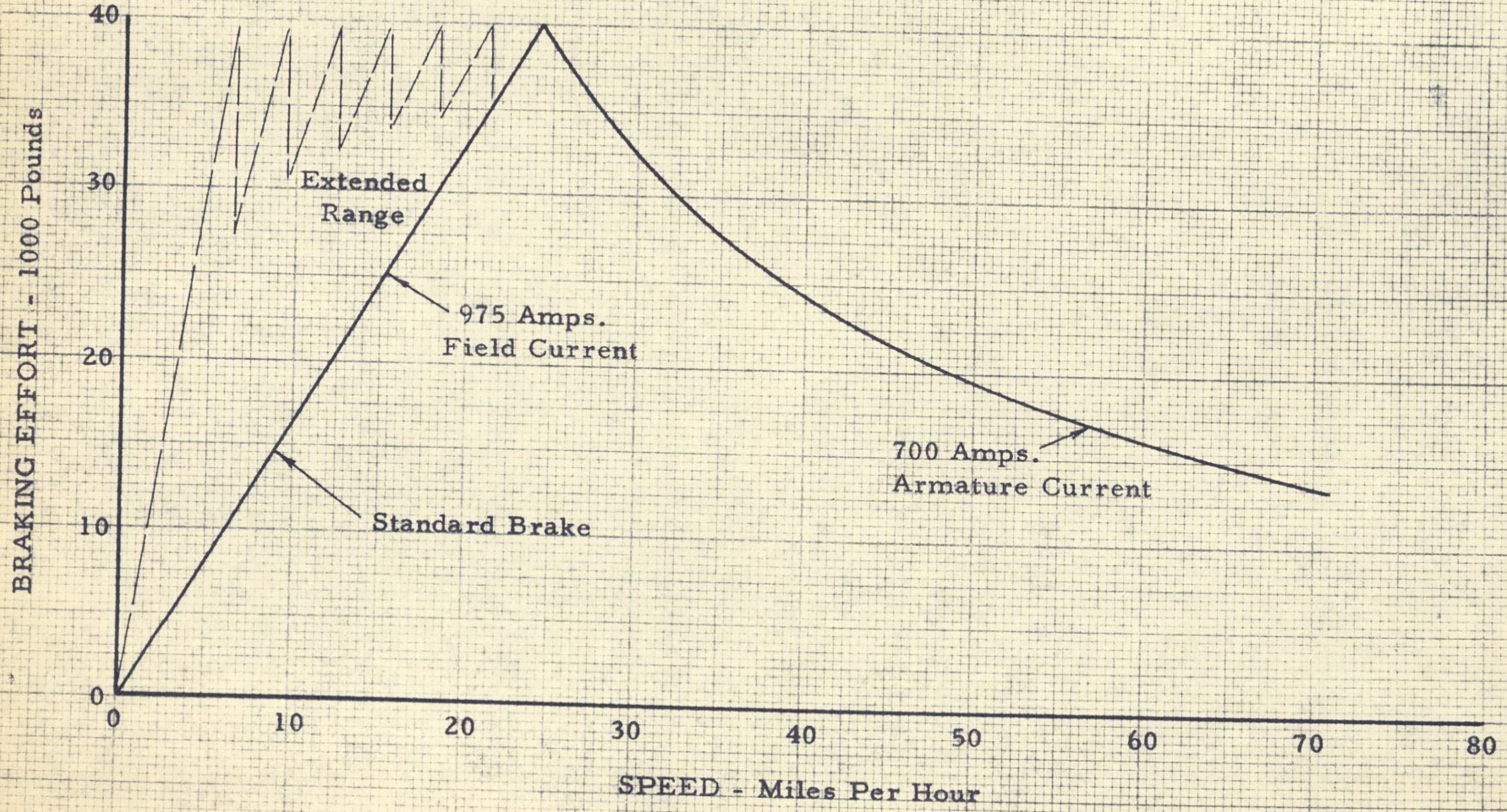
K+E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

10-28-66
Rev. B

DYNAMIC BRAKING EFFORT

Four Motor - 0.86 Ohm Grids
62:15 Gear Ratio
40" Diameter Wheels
Model GP39 Locomotive
Model GP40 Locomotive



Product Application

SC-2563

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO
MADE IN U. S. A.

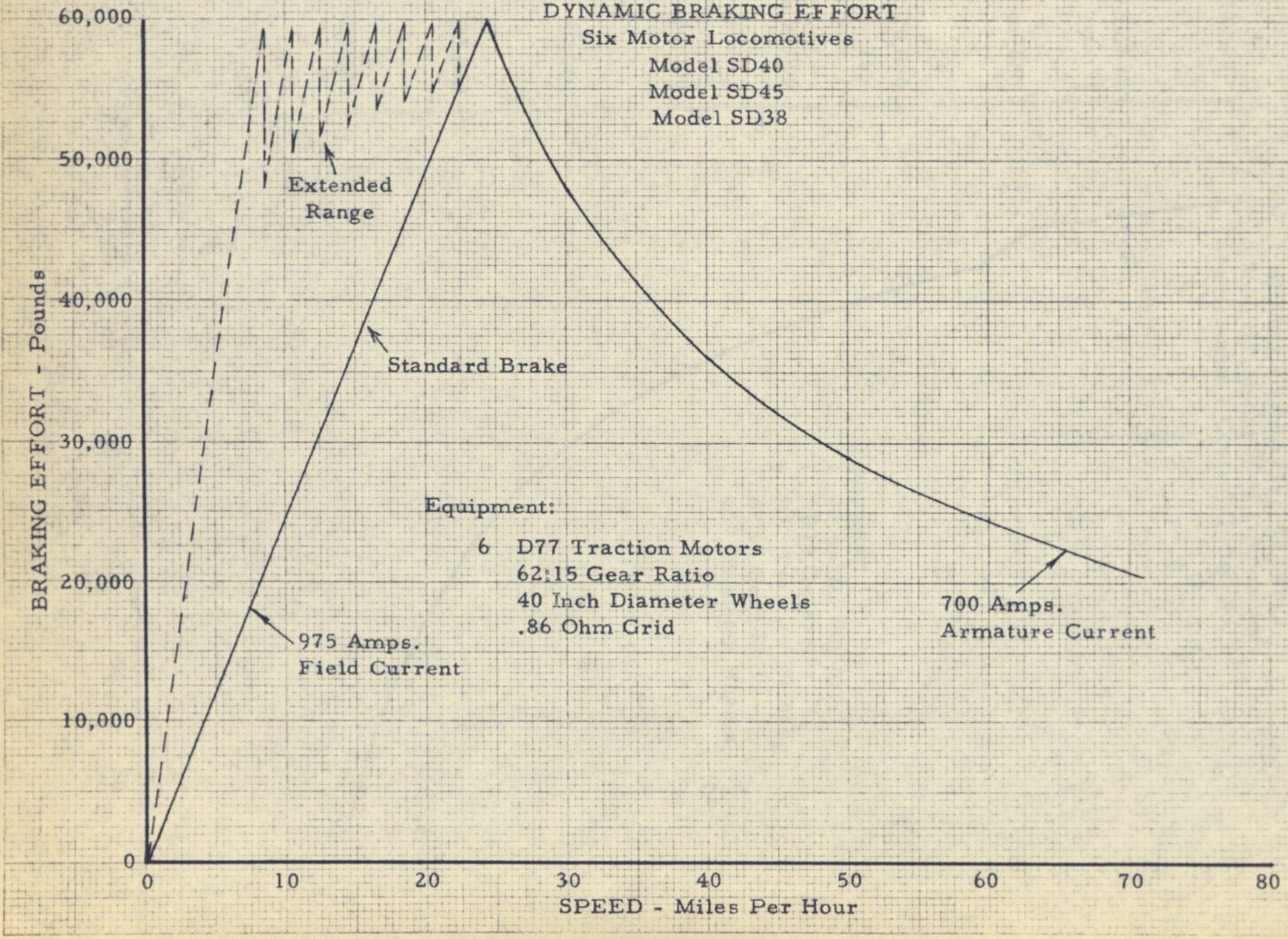
NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

2-22-67
Rev. C

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

DYNAMIC BRAKING EFFORT

Six Motor Locomotives
Model SD40
Model SD45
Model SD38



Equipment:

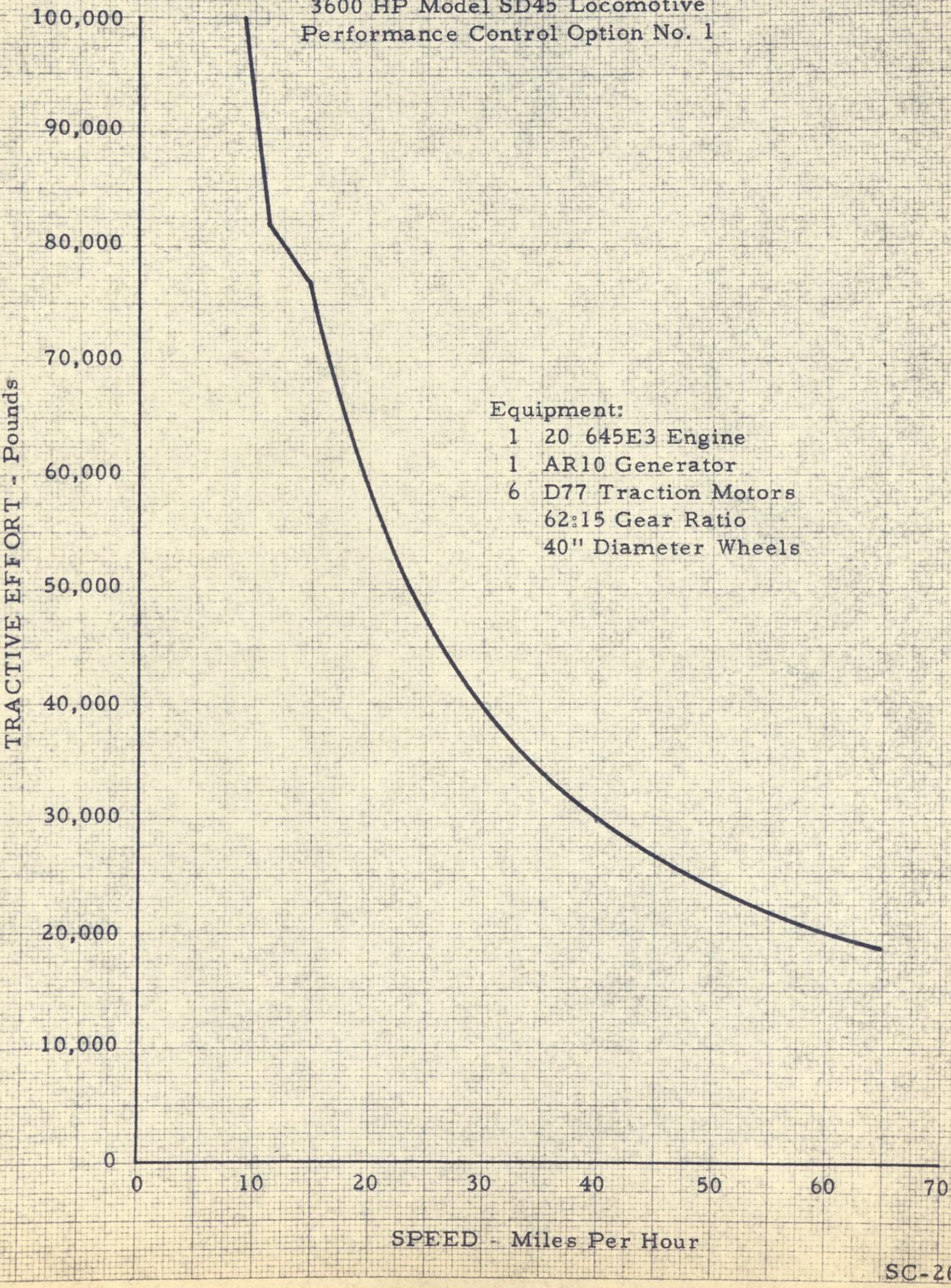
6 D77 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

SC-2570

Rev. C
8-25-70

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3600 HP Model SD45 Locomotive
Performance Control Option No. 1



Equipment:
1 20 645E3 Engine
1 AR10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

SC-2617

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

12/23/71

Mr. J. E. Timberlake

attached are 3 copies
each of Spd-TE &
Dyn Bk curves for
for the SD40 loco
per your request.
Please excuse the
informal note, but I wanted
to get them to you "toot-sweet."
Best regards
Bob Buck

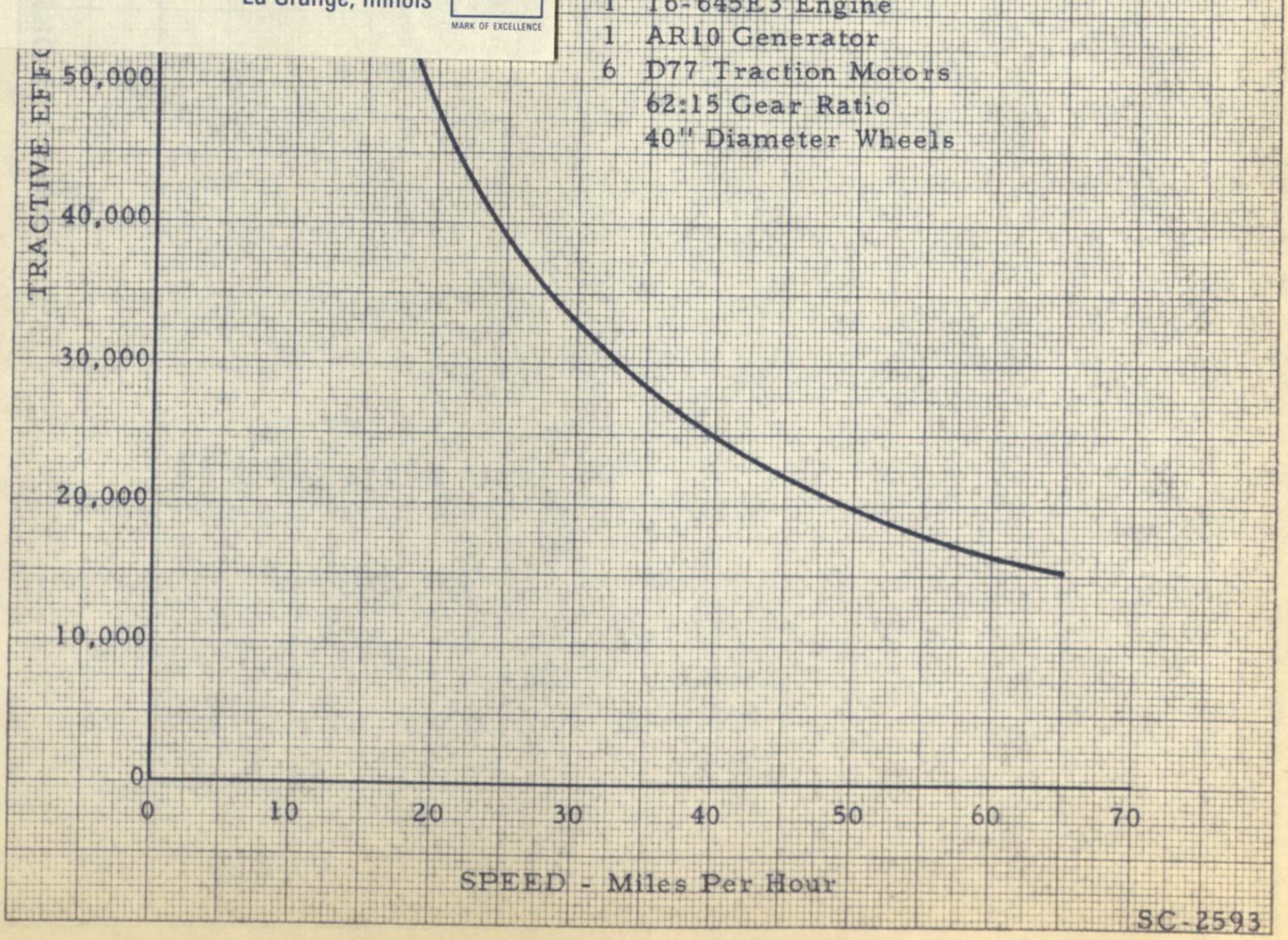
Electro-Motive Division
La Grange, Illinois
GM
MARK OF EXCELLENCE

---

o-Motive Division
Motors Corporation
ge, Illinois, U.S.A.

8-24-70
Rev. A

TRACTIVE EFFORT
odel SD40 Locomotive



Equipment:
1 16-645E3 Engine
1 AR10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

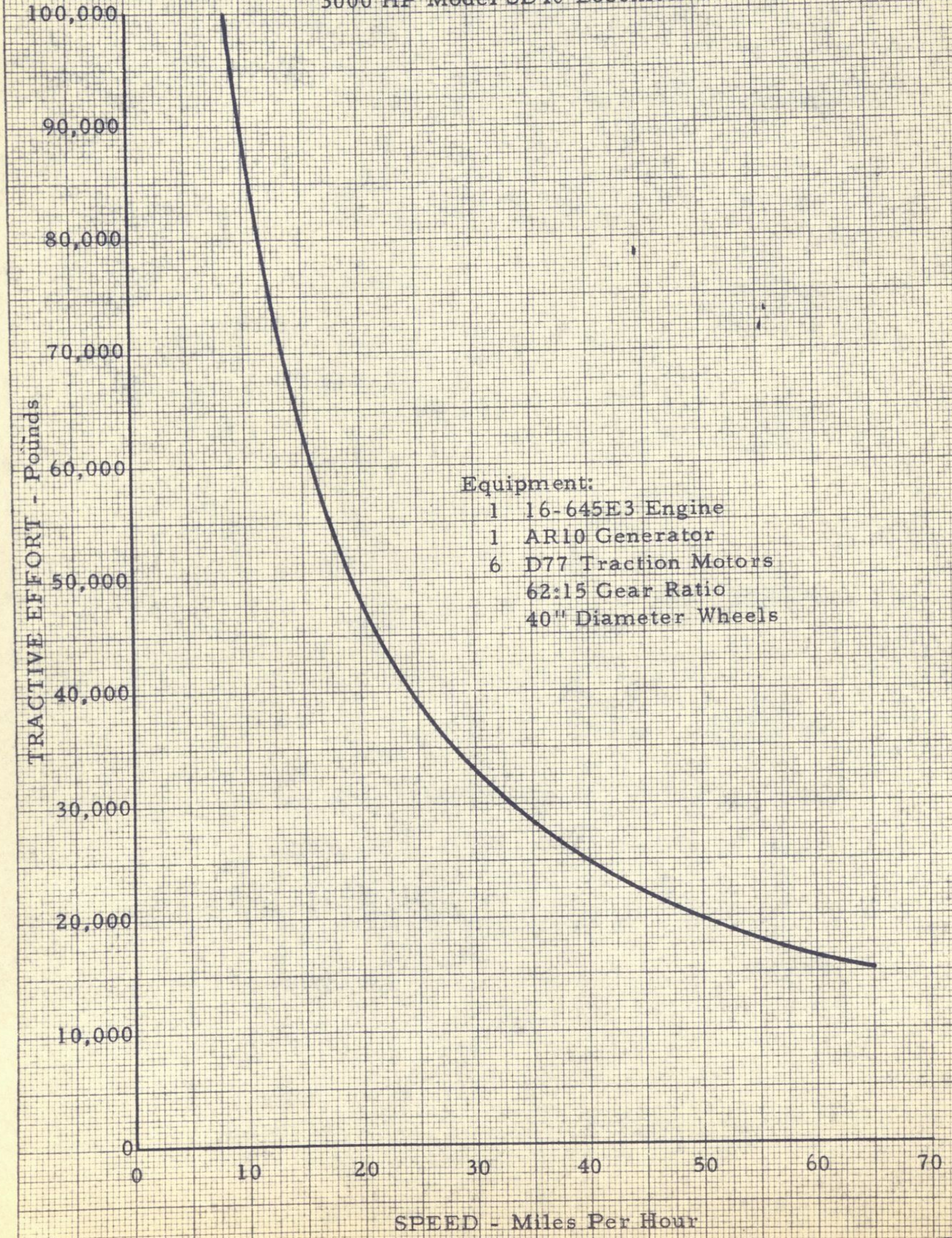
SC-2593

K+E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.

8-24-70
Rev. A

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTIVE EFFORT
3000 HP Model SD40 Locomotive



Equipment:
1 16-645E3 Engine
1 AR10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

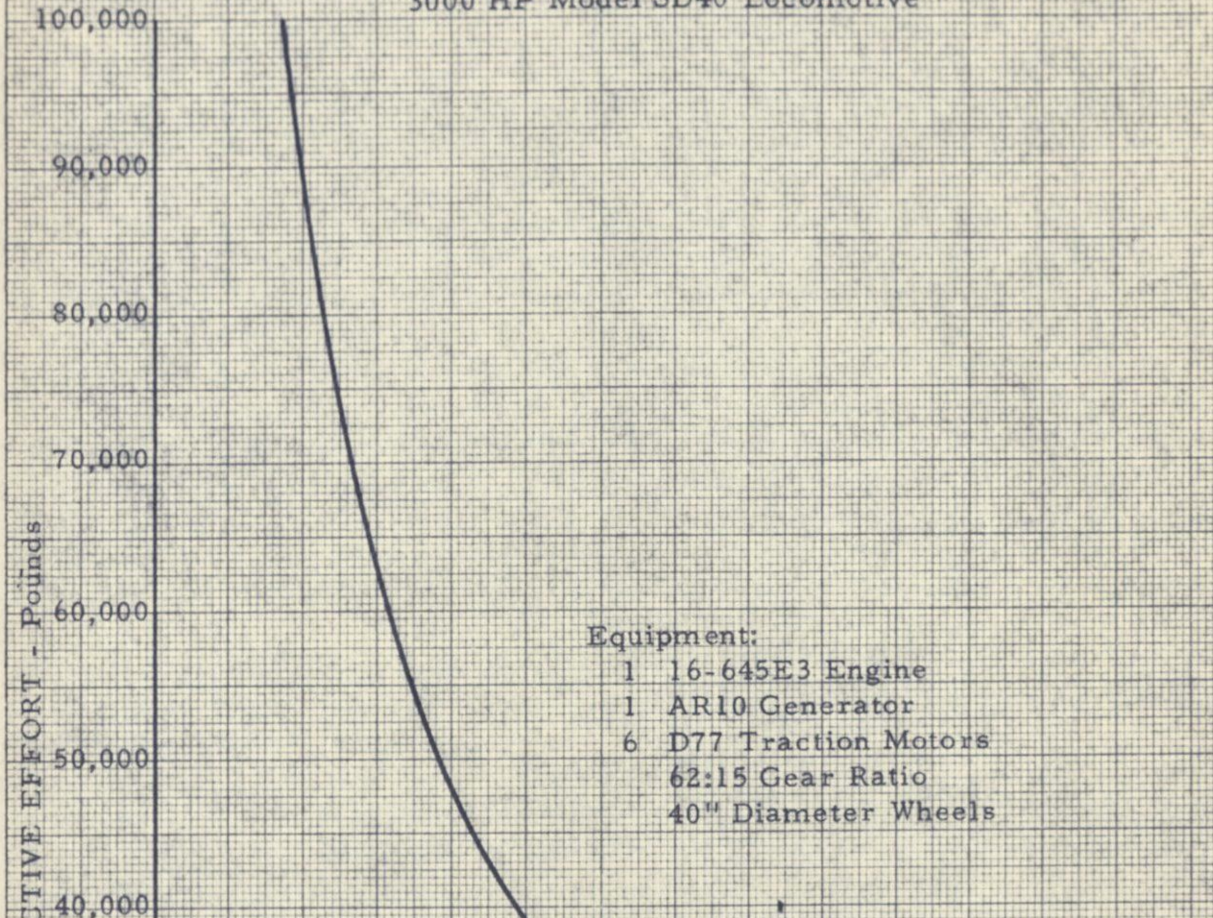
SC-2593

K+E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

8-24-70
Rev. A

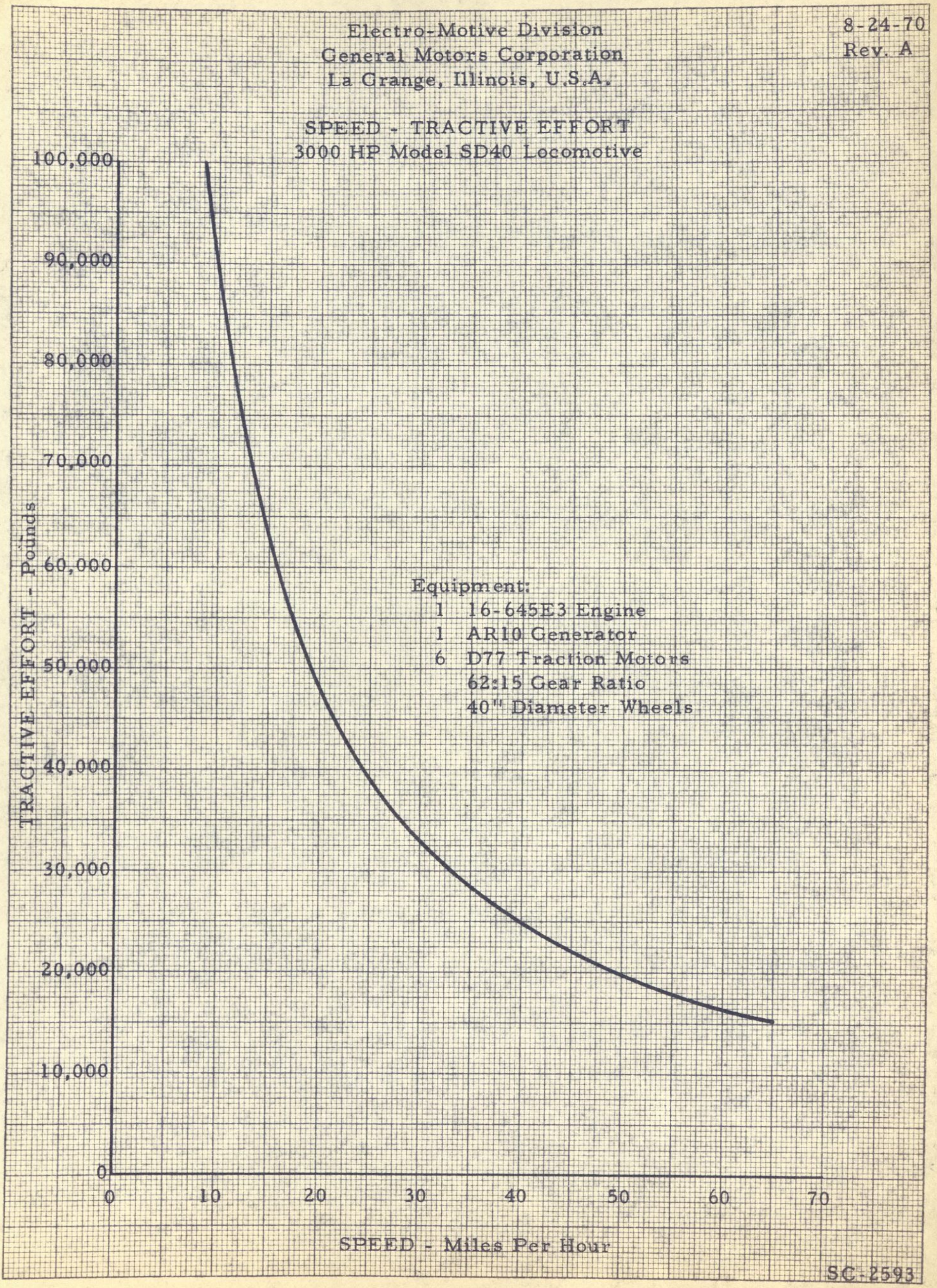
SPEED - TRACTIVE EFFORT
3000 HP Model SD40 Locomotive



Equipment:
1 16-645E3 Engine
1 AR10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

SC-2593

K+E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.



Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

8-24-70
Rev. A

SPEED - TRACTIVE EFFORT
3000 HP Model SD40 Locomotive

Equipment:
1 16-645E3 Engine
1 AR10 Generator
6 D77 Traction Motors
62:15 Gear Ratio
40" Diameter Wheels

SC-2593

K+E 10 X 10 TO THE CENTIMETER 46 1513
18 X 25 CM. MADE IN U.S.A.
KEUFFEL & ESSER CO.

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

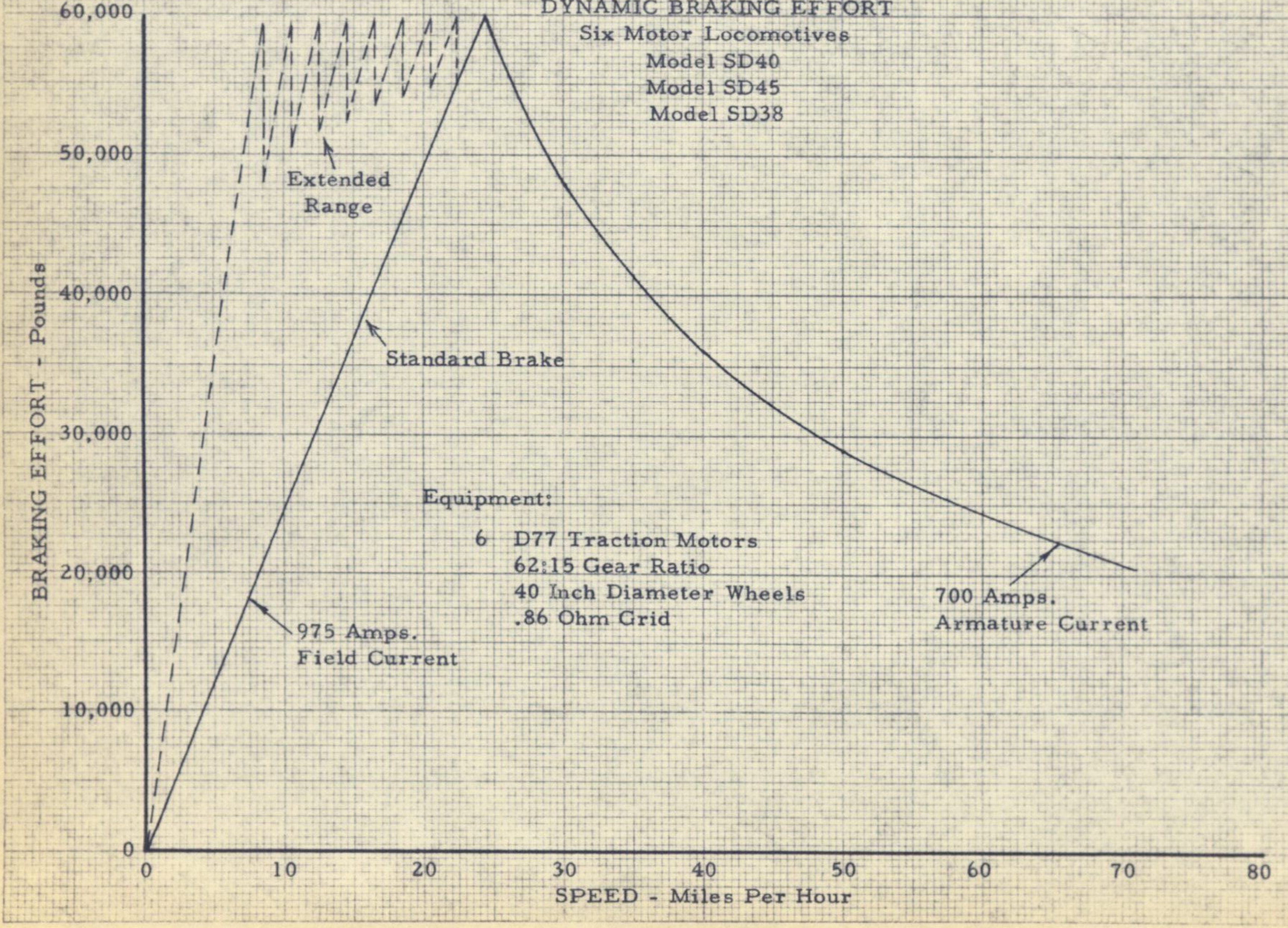
EUGENE DIETZGEN CO.
MADE IN U. S. A.

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

2-22-67
Rev. C

DYNAMIC BRAKING EFFORT

Six Motor Locomotives
Model SD40
Model SD45
Model SD38



Equipment:

6 D77 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

SC-2570

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH

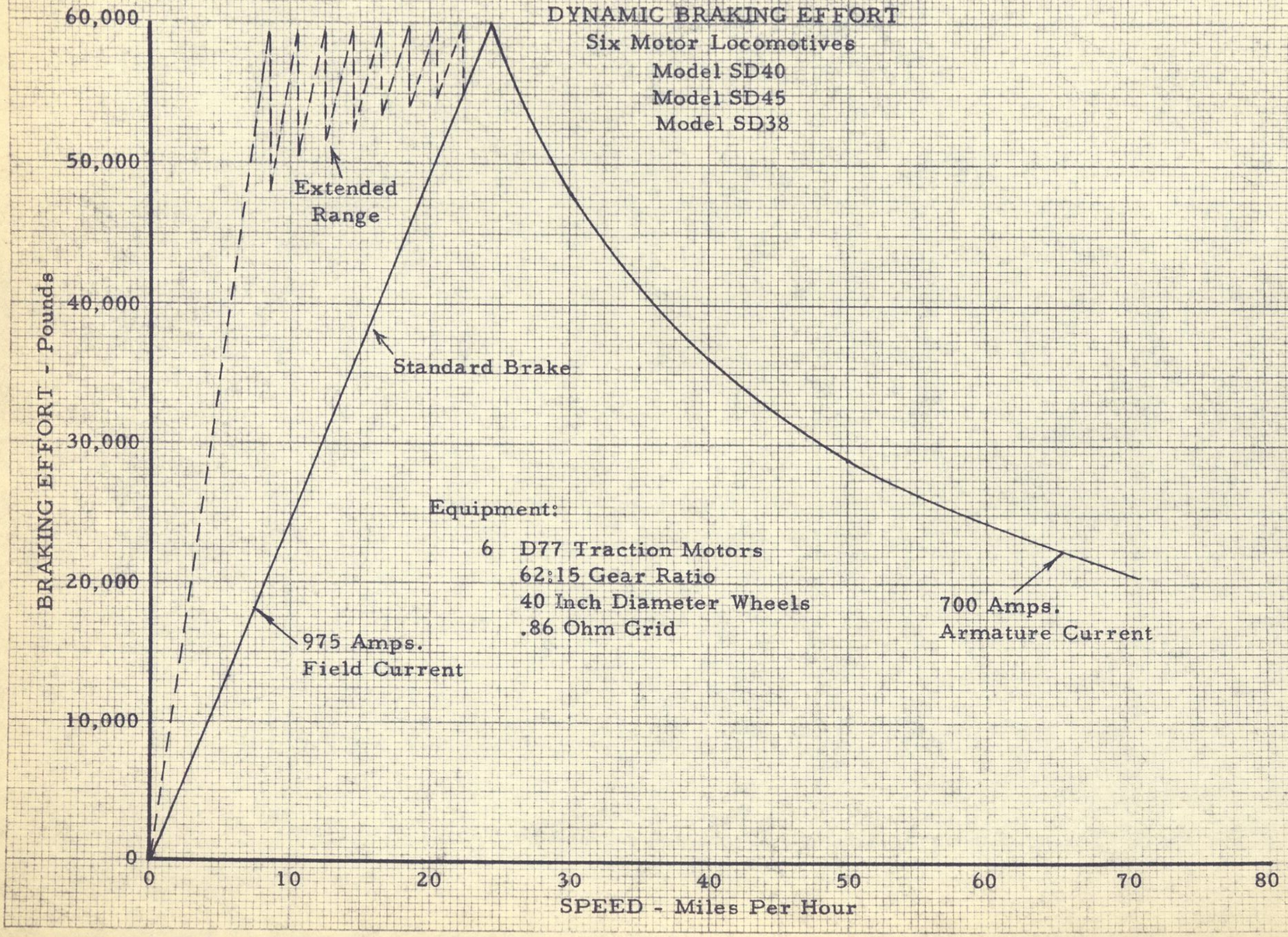
EUGENE DIETZGEN CO.
MADE IN U. S. A.

2-22-67
Rev. C

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

DYNAMIC BRAKING EFFORT

Six Motor Locomotives
Model SD40
Model SD45
Model SD38

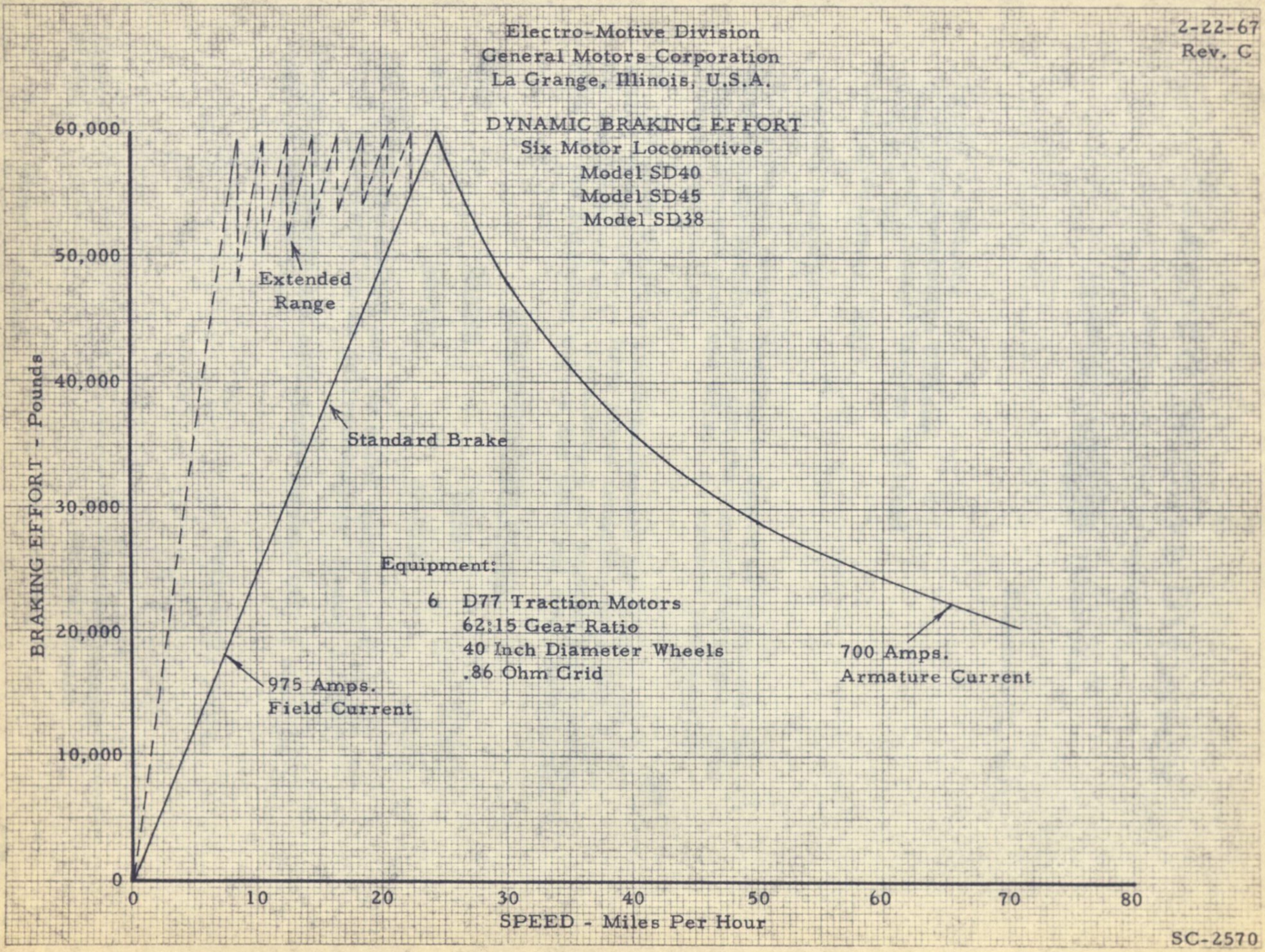


Equipment:

6 D77 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

SC-2570

NO. 340R-20L DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.



2-22-67
Rev. C

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

DYNAMIC BRAKING EFFORT
Six Motor Locomotives
Model SD40
Model SD45
Model SD38

Equipment:

6 D77 Traction Motors
62:15 Gear Ratio
40 Inch Diameter Wheels
.86 Ohm Grid

SC-2570

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE ILLINOIS

December 23, 1971

Mr. D. J. Butters
Chief Transportation Officer
Denver & Rio Grande Western Railroad
P.O. Box 5482
Denver, Colorado 80217

Dear Mr. Butters:

During recent detail meeting in Denver we discussed the maximum permissible speed for the recently delivered GP40 locomotives and also the affect on tonnage ratings with current gear ratios.

At that time I left a speed-horsepower curve with you for a SD45 locomotive. I have since found out that this curve has been revised and, therefore, I am sending you one copy each of the following curves for GP40 and SD45 locomotives.

SPEED-HORSEPOWER CURVES

GP40	GP40-2	SD45	SD45-2
DP-276	DP-277	DP-245A	DP-278

The GP40-2 and SD45-2 are the model designations of the new model locomotives to be delivered after January 1, 1972.

Should you require any additional information, I would be happy to provide it.

Very truly yours,

L.R. Beck

L. R. Beck
District Manager
Central Region

LRB/rg
Attach.

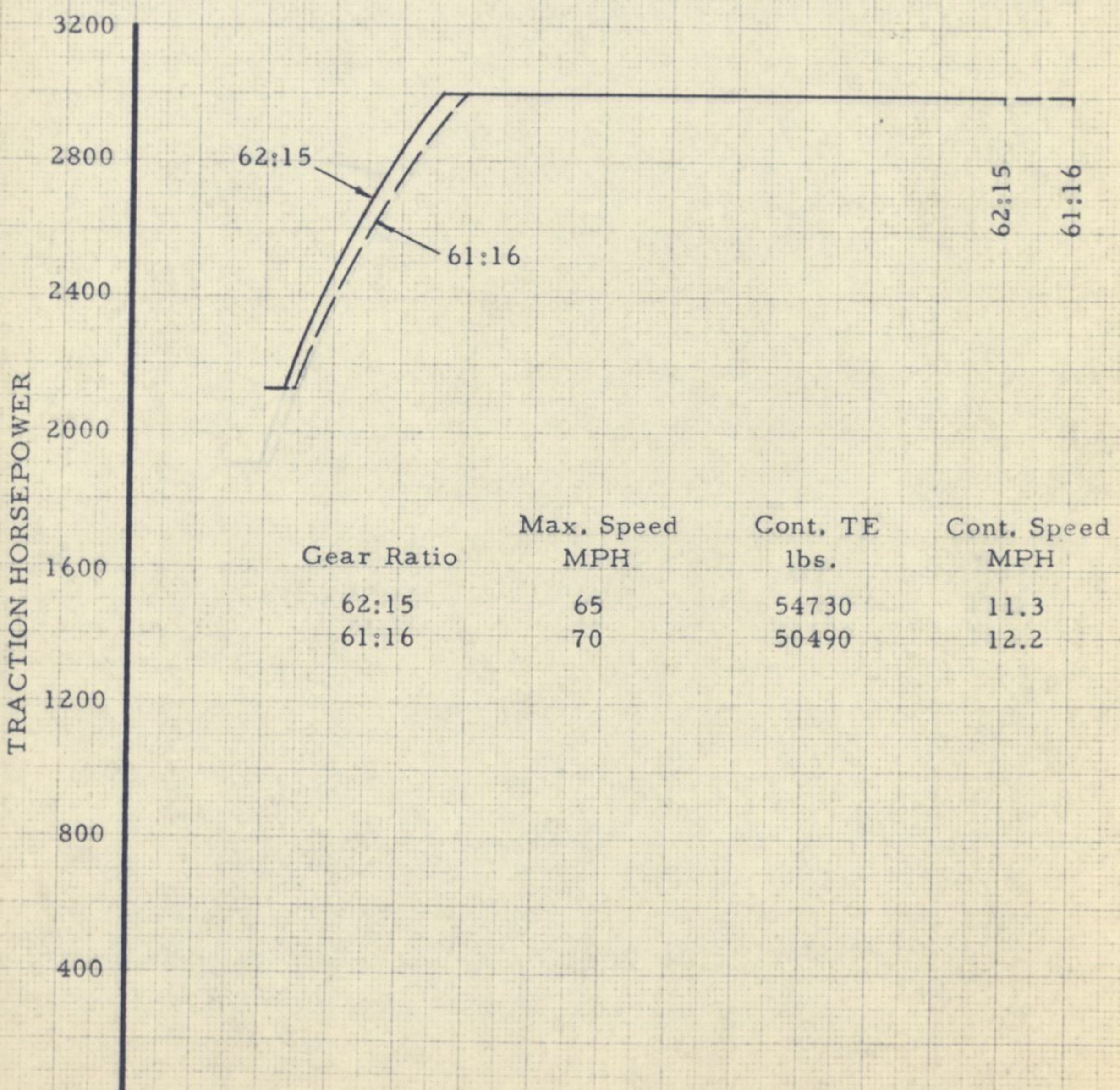
cc: P. D. Starr - Attach.
✓ J. E. Timberlake - Attach.

ZIP CODE 60525

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

12-22-71

SPEED - TRACTION HORSEPOWER
3000 HP Model GP40 Locomotive
Performance Control Option 1



Gear Ratio	Max. Speed MPH	Cont. TE lbs.	Cont. Speed MPH
62:15	65	54730	11.3
61:16	70	50490	12.2

DP-276

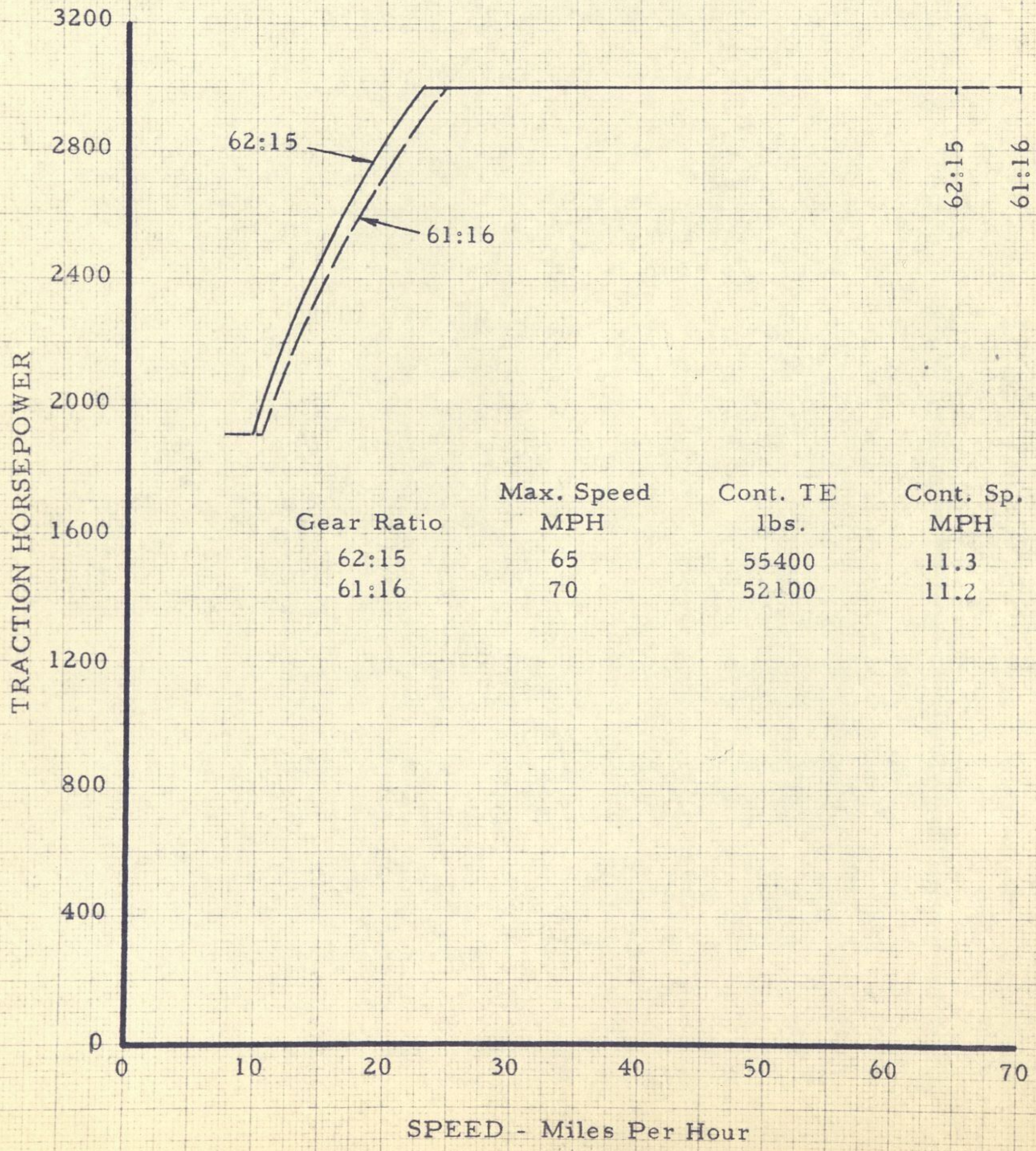
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

YDKey

12-22-71

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTION HORSEPOWER
3000 HP Model GP40-2 Locomotive



Gear Ratio	Max. Speed MPH	Cont. TE lbs.	Cont. Sp. MPH
62:15	65	55400	11.3
61:16	70	52100	11.2

DP-277

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340-MP DIETZGEN GRAPH PAPER
MILLIMETER

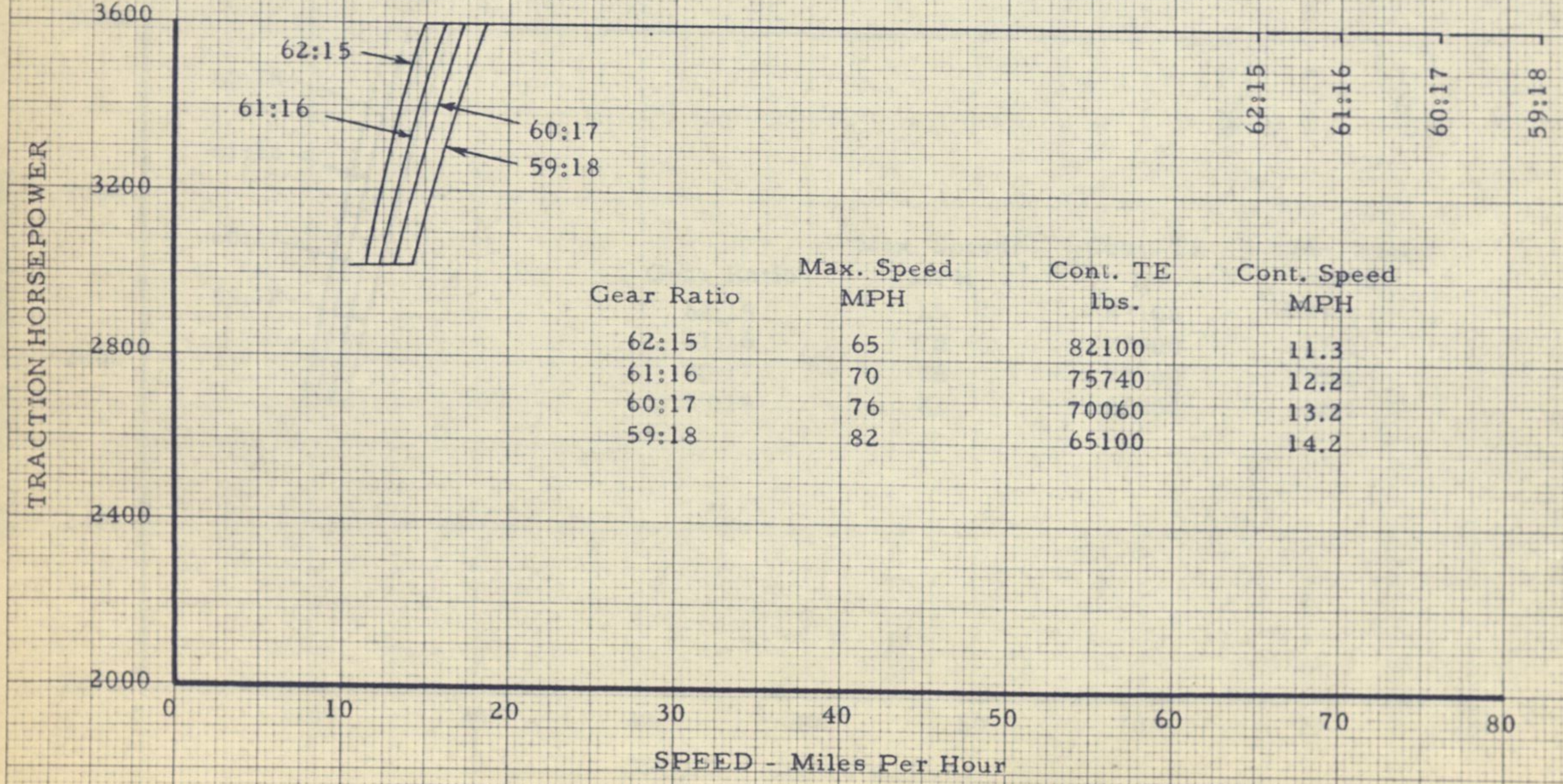
NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

12-23-71

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTION HORSEPOWER
3600 HP Model SD45 Locomotive
Performance Control Option 1



Gear Ratio	Max. Speed MPH	Cont. TE lbs.	Cont. Speed MPH
62:15	65	82100	11.3
61:16	70	75740	12.2
60:17	76	70060	13.2
59:18	82	65100	14.2

DP-245 A

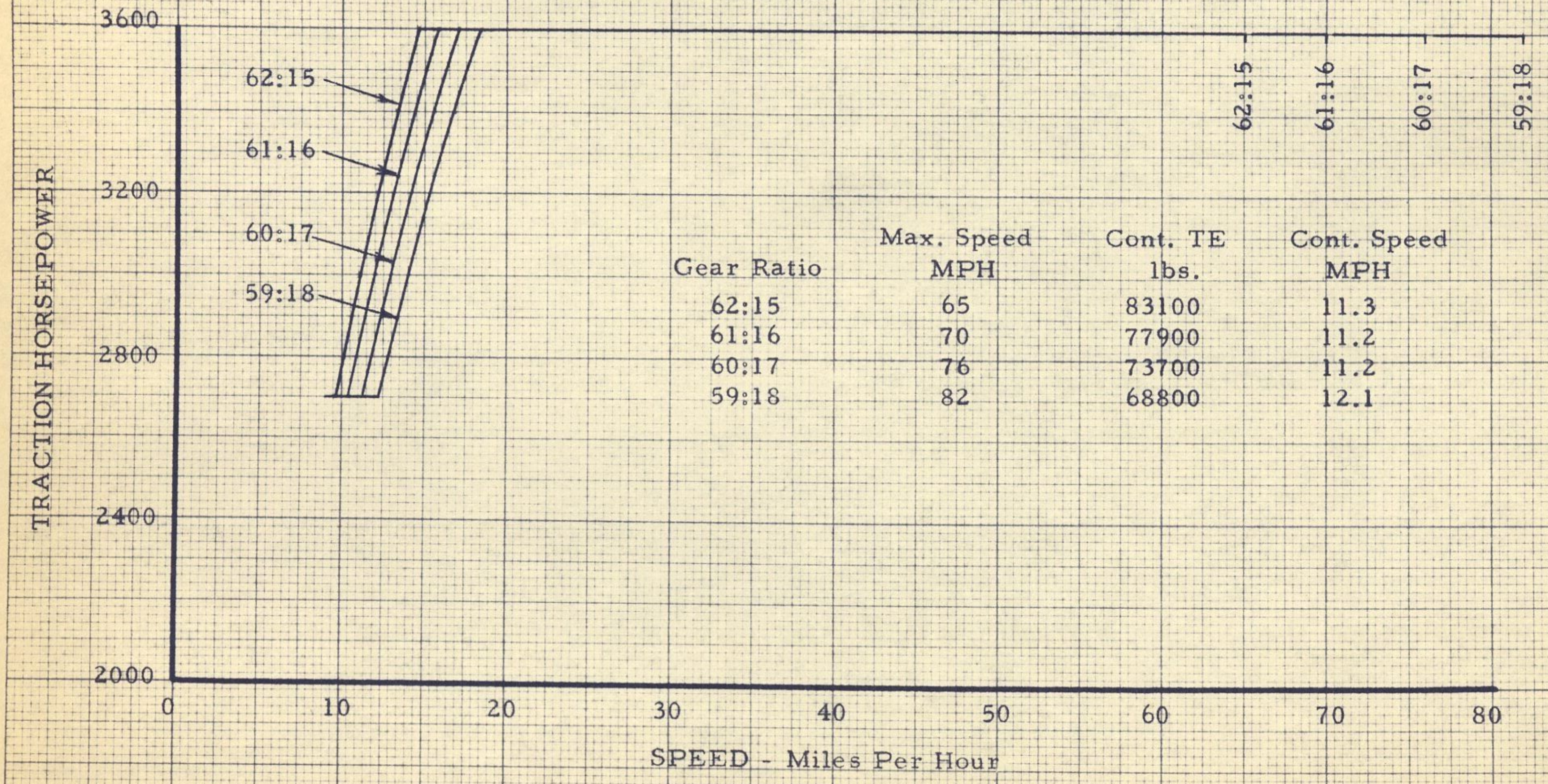
NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

12-22-71

Electro-Motive Division
General Motors Corporation
La Grange, Illinois, U.S.A.

SPEED - TRACTION HORSEPOWER
3600 HP Model SD45-2 Locomotive



Gear Ratio	Max. Speed MPH	Cont. TE lbs.	Cont. Speed MPH
62:15	65	83100	11.3
61:16	70	77900	11.2
60:17	76	73700	11.2
59:18	82	68800	12.1

DP-278

GAB
K

~~JDKay~~ F

Denver - Dec. 15, 1969

Messers. D. J. Butters
P. D. Starr
E. H. Waring

Re: Loading in motion, Edna Mine.

Since previous experience at Sunnyside has shown the ease of downhill loading in plugging mode, with inherent speed regulation at about 1 MPH, I recommend the customer be encouraged all possible to design his facility for this type of loading.

The locomotive units at Sunnyside were found to move at .96 MPH while controlling an average force (calculated) of about 44,000 lbs. each. As nearly as could be measured the loading speed would vary from this value propotionally to the square root of the force being controlled.

Assuming a train of 45 16M series cars with 4 SD-45 units, with gross empty weight of 1418 tons (cars only), gross loaded weight of 5920 tons, and grade of 1.82%, maximum loading speed (while filling last car) would be about 1.12 MPH. Loading speed while filling the first car would be near .64 MPH. Based on the maximum loading speed of 1.12 MPH, coal would need to be moved at 11,400 tons/hr. to keep the train filling. However, since the loading chute would be open only while directly over the car, or about 83% of the time, the chute would need to allow coal to flow at a rate of about 13,700 tons/hr.

Experience has shown that the greatest difficulty in loading is filling the front of each car as it moves under the loading chute. Calculations show that a volume containing about 28.7 tons must be filled while the car is moving from the point of first being under the chute until it is at the point where a full cross-section of coal is achieved. This distance is about 5.65 feet, and the rate needed to fill this volume in this time is 30,000 tons/hr. (assuming a chute of 5' x 5' opening).

Sunnyside uses two chutes, of about 4.5' x 4.5' opening, and easily achieves front end filling at .96 MPH. It appears that this rate is about 13,000 tons/hr. for each chute. In effect, they are moving 26,000 tons/hr. through openings totaling 40 square feet.

However, there is another approach that might be taken. If an elongated chute is used, and if a gate moving in the same direction as the train could be openned at about the same rate as the car moves under the chute, the opening could be started just as the front of each car starts under the edge of the chute. The additional time of opening would reduce the overall flow rate required to about 21,000 tons/hr. Rough approximation indicates this would require an opening of 33 sq. ft., with a gate opening at a rate of 1.64 feet per second.

All calculations are based on loading at the inherent speed of this mode, and while loading the last car, which would be at a speed of 1.12 MPH.

It is assumed that the customer will want to design a chute that will screed the coal to approximately the natural angle of repose. Such a screed should lower to about 12'7", which would put it about one foot above a 16M car. It should also raise to clear locomotive and caboose, to a height of 16'8".

It must be emphasized that this type of control is very steady, and requires no extra control equipment nor low speed speedometers. No special grade preparation will be required. However, if a speed lower than the inherent maximum is used, special care must be taken to be sure track is smooth to reduce speed variations while loading.

(S) F. A. Robinson

cc: JDK
GAB

FAR:mr

12/26/72

JET

I see I have Key's file copy of this letter, herewith returning to you.

I just checked these figures & by some accident they do not look too bad. However, when you get a description of the cars I believe it should all by refigured.

FAR.

Speed-Tonnage-Grade Tables - Explanation of Use -

Sept 23-3 Test Shipments

from Castle Gate

N.B. Somerset

Smead®
No. 2-152-5LAK
HASTINGS, MINN. - LOGAN, OHIO U.S.A.